Level 3 Service Manual

Product Family 38C

Personal Communicator

Model V100
GSM Technology

Table of Contents

Introduction

Motorola® Inc. maintains a worldwide organization that is dedicated to provide responsive, full-service customer support. Motorola products are serviced by an international network of company-operated product care centers as well as authorized independent service firms.

Available on a contract basis, Motorola Inc. offers comprehensive maintenance and installation programs which enable customers to meet requirements for reliable, continuous communications. S

Product Identification

Motorola products are identified by the model number on the housing. Use the entire model number when inquiring about the product. Numbers are also assigned to chassis and kits. Use these numbers when requesting information or ordering replacement parts.

Product Names

Product names included in Product Family 38C Personal Communicators are listed on the front cover. Product names are subject to change without notice. Some product names, as well as some frequency bands, are available only in certain markets.

Product Changes

When electrical, mechanical or production changes are incorporated into Motorola paging products, a revision letter is assigned to the chassis or kit affected, for example; -A, -B, or -C, and so on.

The chassis or kit number, complete with revision number is imprinted during production. The revision letter is an integral part of the chassis or kit number and is also listed on schematic diagrams and printed circuit board layouts.

Regulatory Agency Compliance

This device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

1. This device may not cause any harmful interference, and
2. this device must accept interference received, including interference that may cause undesired operation.

This class B device also complies with all requirements of the Canadian Interference-Causing Equipment Regulations (ICES-003).

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Computer Software Copyrights

About This Service Manual

Using this service manual and the many suggestions contained in it assures proper installation, operation, and maintenance of Product Family 38C Personal Communicators. Refer any questions about this manual to the nearest Customer Service Manager.

Audience

This document provides assistance to service personnel in testing and repairing Product Family 38C Communicators. Service personnel should be familiar with electronic assembly, testing, and troubleshooting methods, and with the operation and use of associated test equipment.

Use of this document assures proper installation, operation, and maintenance of Motorola products and equipment. It contains all service information required for the equipment described and is current as of the printing date.

Scope

The scope of this document is to provide the reader with basic information relating to Product Family 38C Personal Communicators, and also to provide procedures and processes for repairing the units at Level 3 service centers including:

- Unit swap out
- Repairing of mechanical faults
- Basic modular troubleshooting
- Component-level troubleshooting
- Limited PCB component repair requiring unsoldering and soldering
- Testing and verification of unit functionality
- Initiate warranty claims and send faulty modules to Level 4 repair centers.

Finding Information

A product family is identified by the first three digits of the serial number, unless covered by an extended warranty. Extended warranty products have two alphabetic characters in place of the first two digits of the family code. The first digit following the alphabetic code indicates the number of years the warranty period is in effect.

Conventions

Special characters and typefaces, listed and described below, are used in this publication to emphasize certain types of information.

Note: Emphasizes additional information pertinent to the subject matter.

Caution: Emphasizes information about actions which may result in equipment damage.

Warning: Emphasizes information about actions which may result in personal injury.

Enter Keys to be pressed are represented graphically. For example, instead of “Press the Enter Key”, you will see “Press Enter”.

Information from a screen is shown in text as similar as possible to what appears in the display. For example, ALERTS or ALERTS or ALERTS.

Information that you need to type is printed in **boldface type**

Revisions

Any changes that occur after manuals are printed are described in publication revision bulletins (*PMRs*). These bulletins provide change information that can include new parts listing data, schematic diagrams, and printed board layouts.

Warranty Service Policy

The product will be sold with the standard 12 months warranty terms and conditions. Accidental damage, misuse, and extended warranties offered by retailers are not supported under warranty. Non warranty repairs are available at agreed fixed repair prices.

Out of Box Failure Policy

The standard out of box failure criteria applies. Customer units that fail very early on, after the date of sale, are to be returned to Manufacturing for root cause analysis, to guard against epidemic criteria. Manufacturing to bear the costs of early life failure.

Product Support

Customer's original units will be repaired but not refurbished as standard. Appointed Motorola Service Hubs will perform warranty and non-warranty field service for level 2 (assemblies) and level 3 (limited PCB component). The Motorola Hi-Tech Centers will perform level 4 (full component) repairs.

Customer Support

Customer support is available through dedicated Call Centers and in-country help desks. Product Service training should be arranged through the local Motorola Support Center.

Ordering Replacement Parts

Only centers authorized to carry out repairs can purchase spare parts. Orders for spare parts from hubs and Hi-Tech Centers should be placed with the regional Motorola Parts Distribution Center.

General Operation

The Product Family 38C Personal Communicator consists of a transceiver and a microcomputer-controlled decoder, referred to as the controller (see Figure 1).

Messages and calls are received by way of an RF carrier that is frequency modulated by a coded binary sequence. The circuits in the transceiver board section, through a triple-conversion process, convert the RF signal to a low frequency signal that is passed on to the controller. The controller processes the coded data using digital techniques, and controls messages memory, Liquid Crystal Display (LCD), and alert tones.

The controller processes coded messages, and forwards the messages to the transmitter. The transmitter section generates a modulated RF carrier signal, amplifies the signal, then radiates the signal through the antenna.

The following describes the general theory of operation for the Product Family 38C Personal Communicator. See Figure 1 for a simplified, high-level functional block diagram. Circuit descriptions are provided. Detailed functional block diagrams and schematics for the transceiver board and controller are provided in the Supplements listed in Related Publications.

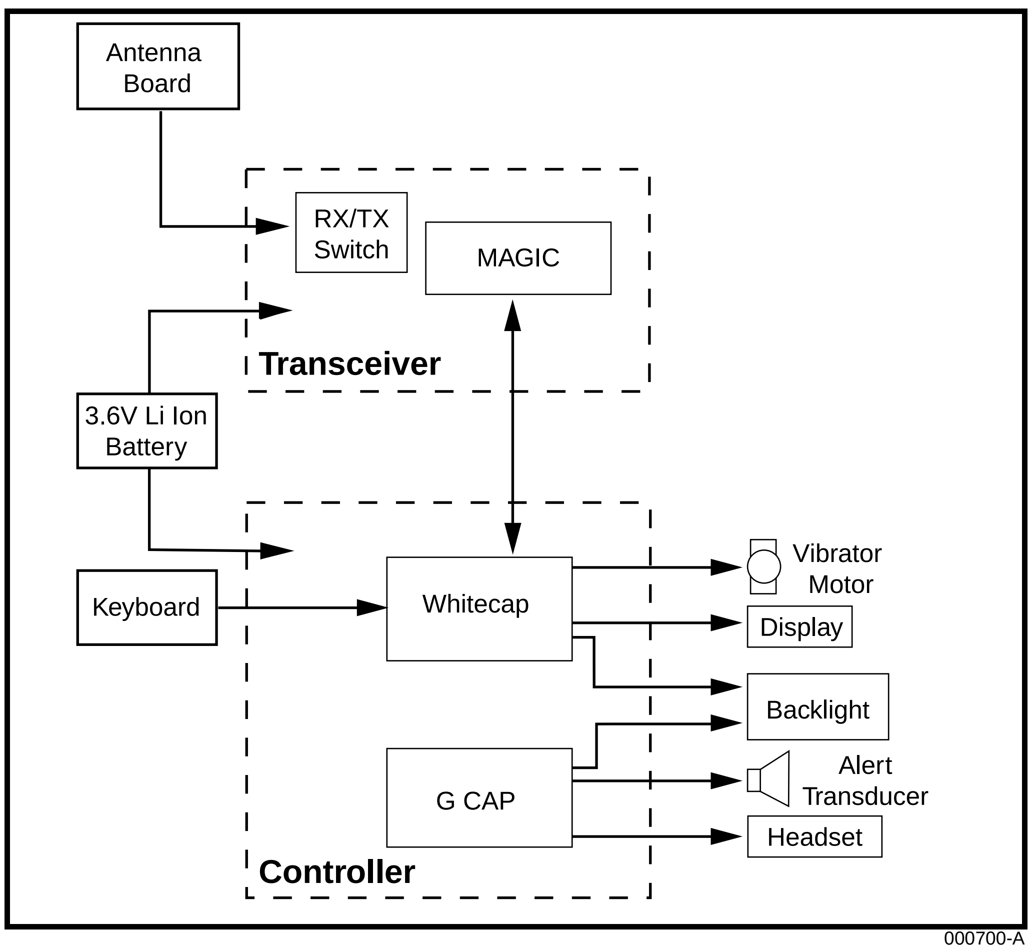


Figure 1. Simplified Functional Block Diagram

Operating Power

The transceiver board and controller circuit boards obtain power from a 3.6V rechargable Lithium Ion battery pack which provides initial power to the communicator and charges the internal power source.

There is a danger of explosion if the Lithium Ion battery pack is replaced incorrectly. Replace only with the same type of battery or equivalent as recommended by the battery manufacturer. Dispose of used batteries according to the manufacturer's instructions.

Nonvolatile Memory/Memory Retention

All messages, device status, and setup information stored in FLASH memory are maintained after removing the primary battery from the device.

To ensure proper memory retention, turn OFF the communicator before removing the battery. Immediately replace the old battery with a fresh battery.

If the battery is removed while receiving a message, the message will be lost.

Circuit Description

Overview

The PF38C Personal Communicator's hardware is capable of operating in the GSM, DCS, and PCS bands. One or more bands may be disabled in the software depending on the country of sale.

Component count has been reduced by use of custom LSI ICs Magic, Whitecap, and G-Cap II. The Magic IC provides the interface between logic and RF sections. During receive it drives the RX VCO, demodulates the IF signal and produces base-band digital data for processing by the logic section. In transmit, it modulates the transmit data using an internal look up ROM and selects the correct band as well as controlling the transmit frequency and power level requirements. Whitecap contains the CPU and interfaces for memory, keypad, display, battery charger, alarms, and SIM (subscriber identity module) card. The G-Cap II IC provides voltage regulation, audio, real-time clock, and logic control functionality.

Receive

The RF signal passes from the antenna to an RF switch. The switch is operated by control voltages that route the signal, depending on whether the receive signal is GSM or DCS / PCS.

If the signal is GSM, it is routed to a bandpass filter that allows only EGSM signals through. The filtered input signal is routed to a low noise amplifier having a fixed gain. The amplified signal is then passed through a second filter that provides additional selectivity before being fed to the Mixer.

A received PCS signal initially follows the same path as GSM. The output from the RF switch is filtered to allow only PCS signals to pass, then fed to the PCS switch. The switch routes the PCS signal to a low noise amplifier. A second provides additional selectivity before passing to the mixer.

The dual transistor mixer is split between GSM and PCS. Output from the RX VCO is mixed with the incoming receive signal, resulting in a mixer output consisting of the sum frequency, difference frequency, and harmonics of the input signal and the RX VCO. The mixer output passes through a SAW filter which passes only the 400 MHz difference signal.

The RX VCO is a single module Colpitts oscillator capable of operating over three bands. It is tuned by the charge pump output from the Magic IC. The charge pump is a steering voltage used to make the oscillator operate at the required frequency.

An isolation amplifier is finely tuned to 400 MHz to amplify the IF and filter spurious signals from the mixer that passed through the SAW filter. The IF signal is then passed into the Magic IC for demodulation and generation of the digital base-band signal.

The 800 MHz local oscillator is the same for all three bands and is controlled by the Magic IC. It is divided by 2 internally in the Magic IC and used to generate baseband I and Q signals. These baseband signals are filtered and amplified to provide RxI and Q. The RxI and Q signals are converted into digital outputs and sent over a serial bus. The chip will provide for AGC control through the SPI bus.

Transmit

Serial transmit Data is fed into the Magic IC. On the rising edge of DMCS, Magic IC samples a TX data bit from the SDTX line. An additional TX data bit is sampled from the SDTX line on every bit clock interval until DMCS goes low. A gated bit clock is provided at TX_CLK. This clock is inverted from the internal bit clock. Thus, when TX_CLK transitions from low to high, a new SDTX bit is sent. The Magic IC reads SDTX on the high to low transition of TX_CLK.

Magic IC contains a look-up ROM to trace out frequency versus time corresponding to GMSK modulation. The modulator will use the present data bit and the previous three data bits to set up one of 16 possible waveforms based on the sum of Gaussian pulses stored in a look up ROM. The resulting signal will then be clocked out at a 16X oversample rate. This data pattern will be input to a four-accumulator fractional N synthesizer with 24-bit resolution.

The charge pump signal is an error voltage supplied from the phase detector internal to the Magic IC. It is an error voltage and is used to tune the TX VCO to the transmit frequency. It first passes through the Tx loop Filter. The circuit is designed to charge a capacitor when TX_EN is initiated to hold the value for the TX VCO during the burst. Data appears on the TX_CP at the same time DM_CS occurs. The circuit, is basically a sample and hold circuit, which takes a sample of the charge pump amplitude voltages and adjusts the charge pump voltage. This corrected voltage is used to tune the TX VCO to the transmit frequency.

Controller

During power-up, the controller checks for battery presence and measures its temperature and voltage. Charger presence and type are also sensed, the keypad and display backlights are turned on, and the 13 MHz clock is started.

The SIM (subscriber identity module) interface is part of the Whitecap IC and supports both synchronous (prepay card) and asynchronous serial data transmission, as well as both 3V and 5V cards.

The charger is capable of supplying the 400mA of current required to support the Personal Communicator in standby while, at the same time, charging its internal battery. Charging current is monitored by the GCAP II. In transmit, the Personal Communicator requires up to 1.5A to be supplied during each burst. During a TX pulse the full 400mA from the charger supports B+ in addition to approximately 1.1A from the battery.

Deep sleep mode saves battery life by intermittently shutting off part of the PCB. Deep sleep mode shutdown is only for a fraction of a second and, during that time, the GCAP Clock supports the logic side of the unit. This clock, output from GCAP and fed directly to Whitecap IC, is monitored by Whitecap IC and, should it fail, the unit is prevented from going into deep sleep mode.

The keypad interface consists of five row and five column pins. The rows are inputs and the columns can be configured either as inputs or outputs. When operating with columns as inputs, any active row or column signal will result in an interrupt. The front keys on the PCB use a three contact design, one of which is tied to ground, while the other two are pulled high and connected to the row and column inputs. When a key is pressed all three of its pads are shorted and grounded. Since each key is uniquely distinguished by the two lines pulled low, no strobing of the keypad is necessary.

The display is a [64 X 126] pixel graphics display and is connected to the PCB via a heat seal connector. The antenna PCB is connected to the controller via a flex connector. The display is made up of glass with polarizers, a display driver and transflector.

Transceiver

Receive

The RF signal from the base station is received through antenna ***A1*** on the antenna board to ***J3*** on the transceiver board or from the RF phasing connector ***TP1***. The signal is fed to ***Pin 10*** or to ***Pin 3*** respectively of RF switch ***U150***. The switch acts as an isolation between TX and RX. RF switch control is provided by ***U151*** which determines whether the switch is opened for TX or RX, and if RF is passed to the Aux RF port or the antenna. RF switching is managed by the following signals:

Table 1. RF Switching Signals

TX_EN	RX_EN	SW_RF (50W Load)	Result
H	L	Loaded	TX through ***TP1***
L	H	Loaded	RX through ***TP1***
H	L	Not Loaded	TX through Antenna
L	H	Not Loaded	RX through Antenna

TX_EN and RX_EN are produced by Whitecap IC ***U800, Pin C1*** and ***Pin E3*** respectively. ***U151*** is supported by the voltages FILTERED -5V (From -5V (***U903***)) and RF_V1(***Q201***).

If a receive signal is present (using GSM 900, for example) in the RF switch, and providing RX275_GSM_PCS (***Q2101***) is high, the receive signal will be passed to band pass filter ***FL400*** which will pass the GSM 900 receive frequency.

RX275_GSM_PCS also selects the PCS 1900 frequency passed through ***FL2400***. The DCS 1800 frequency is selected by RX275_DCS (***Q110***) and passed through ***FL1400***

The PCS 1900 and DCS 1800 signals are fed to DCS/PCS select switch ***U400***. RVCO_PCS and RVCO_DCS (***Q1100***) then selects the appropriate signal, with output tuning provided by ***L1411*** and ***C1411*** for DCS and ***C2411*** for PCS.

The selected signal is fed to a low-noise amplifier circuit. Since this circuit is critical for achieving a very low signal-to-noise ratio, a large amount of external frequency matching and noise reduction circuitry is employed around the actual amplifiers ***Q400*** for GSM (supported by RX275_GSM (***Q110***)) and ***Q1400*** for DCS / PCS (supported by RX275_DPCS (***Q2102***)).

The signal is then fed to ***FL1401*** (For GSM 1800 / 1900) or ***FL401*** (For GSM 900) where harmonics and other unwanted frequencies are removed.

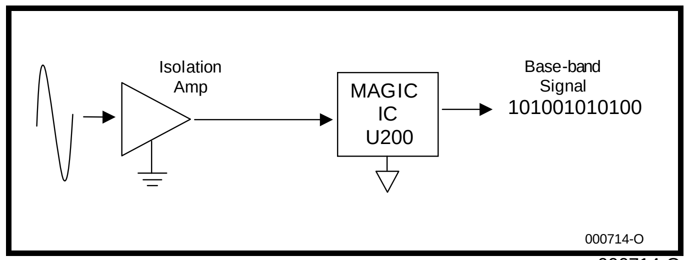
The amplified signal is injected into the base of dual transistor mixer ***Q450***. Both mixers are supported by RX275 (***Q112***). The tuned-emitter biasing voltage is provided by RX275_GSM (***Q110***) and RX275_DPCS (***Q2102***).

RX VCO ***U250*** is driven by the Magic IC ***U200 Pin A1*** CP_RX, which is programmed by the Whitecap IC MQSPI bus. Power is supplied by RVCO_275 (SF_OUT + GPO4 through ***Q1102***).

The generated RX VCO signal is split, with part going back to the Magic IC ***U200 Pin A3*** to serve as the feedback for the RX VCO phase-locked loop. The other part is amplified through tuned transistor amplifier ***Q252*** before being used to mix with the received frequencies through the emitters of the dual mixer transistor ***Q450***.

The mixer produces sum and difference signals consisting of RX frequency *plus* RX VCO frequency and RX frequency *minus* RX VCO frequency. The difference signal is fed to SAW (surface acoustic wave) filter ***FL457***. The purpose of the SAW filter is to provide comprehensive removal of harmonics created during the mixing process.

The resulting 400 MHz IF signal is passed to isolation amplifier ***Q480***. The isolation amplifier couples the analog IF signal to the following circuit which has a different ground and also protects the base-band signals from stray RF. The isolation amplifier is supported by Magic IC ***U200 Pin C7*** SW_VCC.



000714-O

Figure 2. IF Isolation Amplifier Operation

The IF signal is then passed to the Magic IC ***U200 Pin A7*** PRE IN where it is demodulated using external 800 MHz varactor diode ***CR249*** (RX local oscillator set up), which is driven by from Magic IC ***U200 Pin A9*** LO2_CP.

The demodulated signal is converted internally to base-band digital form and passed along the RX SPI bus to the Whitecap IC.

The RX SPI signal is made up of BDR (base-band data receive), BFSR (Base-band Frame Synch Receive) and BCLKR (base-band clock receive), fed from Magic IC ***Pin G8***, ***Pin G9***, and ***Pin F7*** respectively.

The Whitecap IC ***U800*** receives these signals on ***Pin A3***, ***Pin D4***, and ***Pin B4***. Within the Whitecap IC the signal is digitally processed to reduce Baud rate and remove error correction bits.

The resulting digital signal is fed down the DIG_AUD_SPI bus to the GCAP II ***U900***, where it is converted to analog form and distributed to the correct outputs:

The Alert is generated within the Whitecap IC, given the appropriate data from the incoming signal or SMS, and is fed to the alert pads ***LS1***. This signal is supported by ALRT_VCC, which is generated from B+ through ***Q903***.

For the headset only, the SPKR signal is used from GCAP II Pin ***H6***. The output is fed out to the headset jack ***J504 Pin 3***.

Transmit

Analog voice is fed from the Aux Microphone attached to the headset and is routed from ***Pin 1*** of the headset jack ***J504*** to GCAP II, ***Pin H3***.

Within the GCAP II, the analog audio is converted to digital and clocked out onto the DIG_AUD SPI bus to the Whitecap IC ***U800***.

All information about the transmission burst is formulated within the Whitecap IC (timing of the burst, transmit channel, error correction protocol, and in which frame the information will be carried to the base station). All this information is then added to the digitized audio and is transferred to the Magic IC ***U200*** along the TX SPI bus. The bus is made up of BCLKX (base-band clock transmit) ***Pin B3*** and BDX (base-band data transmit) ***Pin B6***. Since the timing for this data is already decided for the transmission burst, a frame synch is not required.

The SPI comes into the Magic IC at Pin ***G7*** BCLKX and Pin ***J2*** BDX.

Magic IC operation is very complex. With respect to the transmit path, however, it integrates Modem, GMSK (Gaussian minimum shift keying), and TIC (translational integrated circuit) functionality.

A very basic block view of how the transmit path works within the Magic IC is shown in Figure 3.

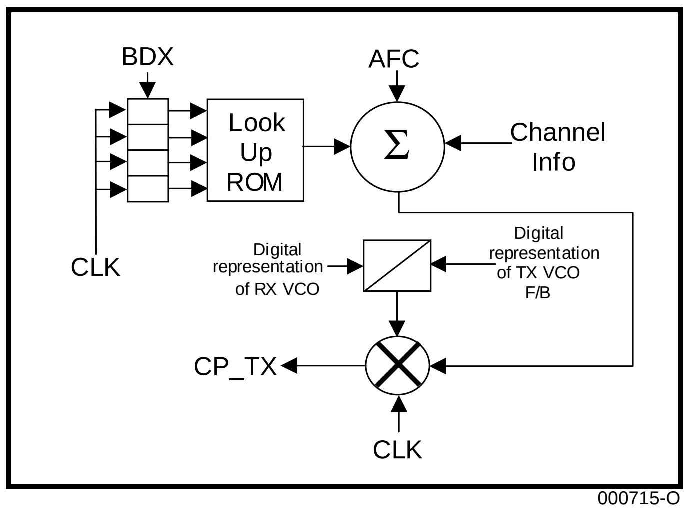


Figure 3. Magic IC Internal Transmit Path

Data is transmitted from Whitecap IC to Magic IC on TX SPI bus BDX. Within the Magic IC, each bit of data is clocked into a register. The clocked bit, and the three preceding bits on the register, are then clocked into a look-up ROM which looks at the digital word and, from that information, downloads the appropriate GSMK digital representation. Channel information and AFC information from Magic IC SPI is then added to this new digital word. The resulting word is representative of the TX IF frequency of GIFSYN products. As in the case of the TIC, the TX frequency feedback and the RX VCO frequency are mixed to give a difference signal which is digitally phase-compared with the "modulation" from the look-up ROM. The difference creates a DC error voltage CP_TX that forms part of the TX phase-locked loop.

The error correction voltage CP_TX is then fed from ***Pin B1*** of Magic IC to ***Pin 4*** of the TX VCO IC ***U350*** through the TX loop filter.

The loop filter, made up of ***U360***, ***Q360***, ***Q361***, and ***C367***, smooths out overshoots in CP_TX when the channel is changed (see Figure 4). If this overshoot were fed to the TX VCO, the resulting burst would not meet the world standards for GSM with respect to bandwidth as shown in Figure 5.

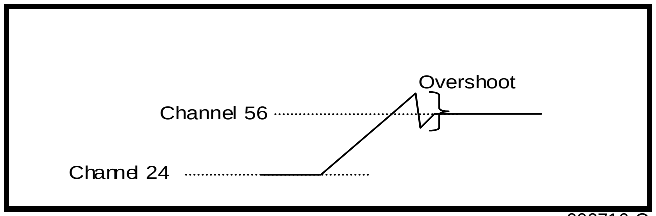


Figure 4. CP_TX Overshoot

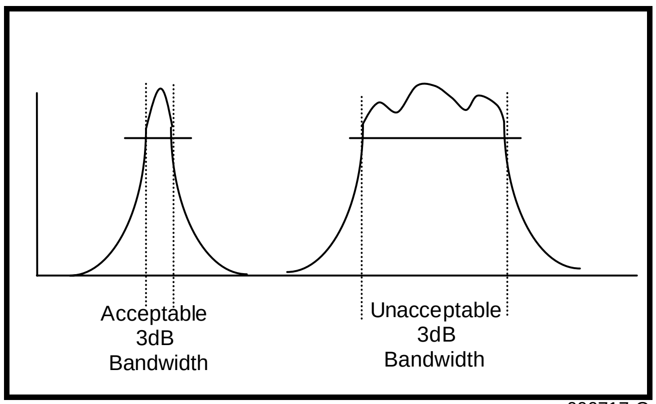


Figure 5. GSM Bandwidth Standard

The loop filter acts as a very large capacitor and resistor to introduce a long R-C time for smoothing. It uses a small capacitor and the very high input impedance of an op amp buffer. During the TX_EN (Whitecap IC ***Pin C1***) period when the transmitter is preparing to operate, the capacitor charges. On receipt of DM_CS (Whitecap IC ***Pin E2***), when the Transmitter actually fires, the capacitor discharges through the op amp giving a smooth TX VCO tuning voltage. The support voltage for the loop filter is V1_FILT (V2 from GCAP II through ***Q913*** which creates V1_SW. V1_SW, in turn, creates V1_FILT).

The TX VCO IC produces the required output frequency and is controlled by:

- TX_DCS (TX275 + DCS_SEL through (***Q1101***)
- TX275_GSM (GSM_SEL + RX275) (***Q110***)
- TX275_DPCS (GSM_SEL + RX275) (***Q2102***)

These signals configure the VCO for correct mode of operation (GSM 900 / 1800 / 1900), support voltage being SF_OUT (Magic IC ***Pin C1***).

The TX VCO signal is then fed through buffer amplifier ***Q330***, which is supported by TX275. The TX VCO signal is split, a sample of the output frequency being directed back to the Magic IC ***Pin A3*** for use within the TIC part of the Magic IC to implement the TX phase-locked loop.

Isolation diode ***CR330*** prevents unstabilized TX VCO output from being amplified and transmitted. ***CR330*** is biased on by the exciter voltage from the PAC IC (power amplifier control IC) ***U390 Pin 7*** which allows the TX output frequency through to exciter amplifier ***Q331*** and, at same time, gives more or less drive to the exciter stage.

The output of ***Q331*** is fed to wide bandwidth PA ***U300*** which is controlled by the exciter voltage from the PAC IC. ***U300*** is supported by a -ve biasing voltage created and timed by TX275 (RF_V2 + TX_EN through ***Q120***), filtered -5V (-5V) and DM_CS (Whitecap IC ***U800 Pin E2***). ***U300*** is also supported by the voltage PA B+ (DM_CS + B+ through ***Q380***).

PA matching is controlled with TX_GSM (TX275 + GSM_SEL through ***Q1101***) and TX_DCS (TX275 + DCS_SEL through ***Q1101***) which switches on or off diodes ***CR300*** through ***CR306*** to match the PA for GSM or DCS / PCS with the inductive strips on the PCB.

The amplified signal is then fed to RF switch ***U150***, as discussed in *Transceiver: Receive* on Page 9. The amplified signal is either transmitted through antenna ***A1*** or routed to accessory socket RF port ***J600 Pin 2***.

Power Control Operation

The Power Amplifier Control (PAC) IC ***U390*** controls the power output of the transmitter. Below is a list of the main signals associated with the PAC IC and their function.

- RF detector RF_IN (***U390 Pin 2***) provides a DC level proportional to the peak RF voltage out of the power amplifier. RF_IN is taken via an inductively coupled stripline at the output of the PA.
- DET_SW (***U390 Pin 11***) controls the variable gain stage connected between the RF detector and the integrator. When DET_SW is low, stage gain is unity. When DET_SW is high (floating), the gain is three.
- TX_KEY (***U390 Pin 10***) pre-charges the exciter and PA. It occurs 20ms before the start of a transmit pulse.
- EXC (***U390 Pin 7***) drives the power control port of the exciter. Increasing this voltage causes the exciter to increase output power.
- SAT_DET (***U390 Pin 12***). If the feedback signal from the RF detector lags too far behind the AOC signal this output goes low indicating that the loop is at or near saturation. SAT_DET signals the DSP to reduce the AOC_DRIVE signal until SAT_DET rises (see Figure 6).

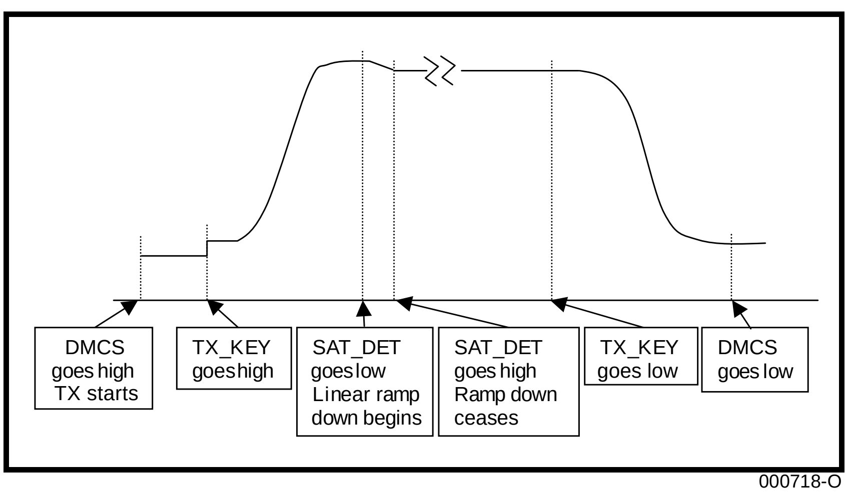


Figure 6. Saturation Detect Signal Control of PA Drive

- AOC_DRIVE (***U390 Pin 8***) controls the output power of the transmitter. Under normal conditions, the control loop will adjust the voltage on EXC so that the power level presented to the RF detector results in equal voltages present at INT and AOC. The input level is between 0 and 2.5V.
- ACT (***U390 Pin 9***). With no RF present, this pin stays high. Once the RF level increases enough to cause the detector output to rise a few millivolts, this output goes low. ACT is connected to the AOC input through a resister which causes the transmitter to ramp-up the power until the detector goes active.

Controller

Power-Up sequence

The three power sources available for the PF38C Personal Communicator are:

- Internal battery
- External power via mid-rate charger (Battery must be present to power up)
- External power via fast charger (Battery must be present to power up)

Battery Power Source

The Personal Communicator uses a 3.6V Lithium Ion battery. Power from the battery is taken from BATT + (battery contacts ***J604***) and routed through battery FET ***Q901***. Once B+ is available, the unit carries out the following checks.

- Battery temperature is measured to establish whether rapid charge is required. Table 2 shows voltages appearing at BATT_THERM_AD (***J604 Pin 3*** and ***GCAP II Pin B3***) for various battery temperatures.

Table 2. Battery Temp vs. BATT_THERM_AD

-40° C	2.75V
25° C	1.39V
40° C	0.96V

- Presence and type of charger is sensed MANTEST_AD (***J600 Pin 5*** and ***GCAP II Pin A1***). This is achieved by using different sense resistors within each type of charger.

Table 3. Charger Type vs. MANTEST_AD

Fast Charger	2.13V
Mid-Rate Charger	1.38V

- Battery voltage is sensed (***GCAP II Pin F7*** BATTERY).
- Input B+ level is sensed (***GCAP II Pin E10*** B+).

Charger Power Source

When the charger is connected to accessory plug ***J600***, EXT B+ is available at ***Pin 14*** and sensed at MOBPORTB (GCAP II ***U900 Pin D10***). Once sensed, the power is passed through protection diode ***CR903*** and output to EXT B+ FET ***Q905***. The output is controlled by MIDRATE_1 and power is made available at B+. Because the charger supports both the Personal Communicator and its internal battery, the battery is charged at the same time B+ is supplied to operate the unit.

The GCAP II is programmed to Boost Mode (5.6V) by PGM0 ***Pin G7*** and PGM1 ***Pin G8*** both being tied to Ground. Once B+ is applied to GCAP II ***Pin K5***, all the appropriate voltages to supply the circuit are provided. These are:

- V1 - Programmed to 5.0V. V1 is at 2.775V at immediate power-on, but is "boosted" to 5.0V through the switch mode power supply ***L901*** / ***CR902*** and ***C913***. See Figure 7 for basic operation. V1 supplies the DSC bus drivers, negative voltage regulators and Magic IC. V1 is created from GCAP II Pin ***A6*** and can be measured at ***C906***.

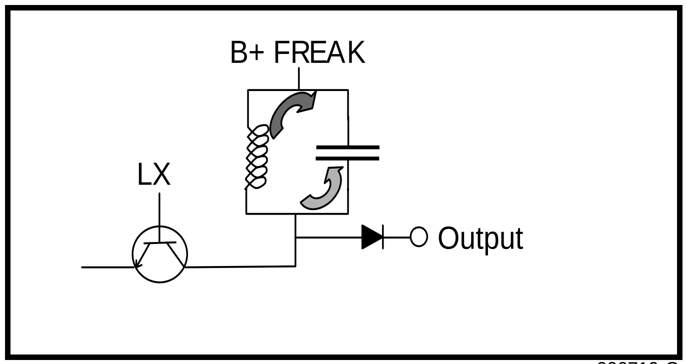


Figure 7. V1 Boost Circuit

Basic circuit operation for the boost circuit is as follows: The LX signal (GCAP II ***Pin B10***) allows a path for B+ to charge the capacitor when the switch is on. When the switch is off, the capacitor discharges through the inductor setting up an electric field. The field then collapses setting up back EMF to charge the capacitor, and so on. The back EMF created by the inductor is greater than B+, with the +ve half of the cycle passing through the diode to charge a capacitor that supplies the V_BOOST voltage. The frequency of the switching signal LX determines the duty cycle of the output wave and therefore the resultant voltage. V_BOOST is fed back into the GCAP.

- V2 - Programmed to 2.775V is available whenever the radio is on and supplies most of the logic side of the board. V2 is supplied from of GCAP II ***Pin J2*** and can be measured at either ***C939*** or ***C941***.
- V3 - Programmed to 2.003V to support the Whitecap IC, but does not support the normal 2.75V logic output from the Whitecap IC. V3 originates from GCAP II ***Pin B5*** and can be measured at ***C909*** or ***C910***.
- VSIM1 - Used to power either 3V or 5V SIM cards. VSIM1 is dynamically set to 3V upon power up. If, however, the card cannot be read, the SIM card is powered down and attempted to be read at 5V. VSIM1 can be measured at ***C905*** and is distributed from GCAP II ***Pin C6*** (See *Controller: SIM Card Interface* on Page 17).
- VREF - Programmed to 2.775V like V2. VREF provides a reference voltage for the Magic IC and Deep Sleep circuit, is distributed from GCAP II ***Pin G9***, and can be measured at ***C919***.
- -5V - Used to drive display and generate -10V. The -5V is also used for RF GSM / DCS selection signals through ***U151***. Both voltages are derived from V1 through ***U903*** and ***U904***.
- SR_VCC (power cut circuit) - Used to buffer SRAM ***U702*** voltage with a built in soft reset within the unit's software. SR-VCC protects the user from accidental loss of power for up to 0.5 seconds, as might occur if the unit is dropped, causing a slight battery contact bounce. SR_VCC allows the unit to appear to be running normally while, internally, a reset is occurring. During this loss of power the unit takes its power from RTC BATTERY+ which originates from

GCAP II ***Pin D6***.

Once a power source has been selected, PWR_SW must be toggled low. This can be done by pressing power key ***S500*** to create ON_2, which is supported by PWR_SW (GCAP II ***Pin C8***). ON_2 is also pulled low when an external [fast] charger is plugged in, providing a battery is present. (See also "Charger Circuit" on page 18.)

The power-up sequence continues as shown in Figure 8.

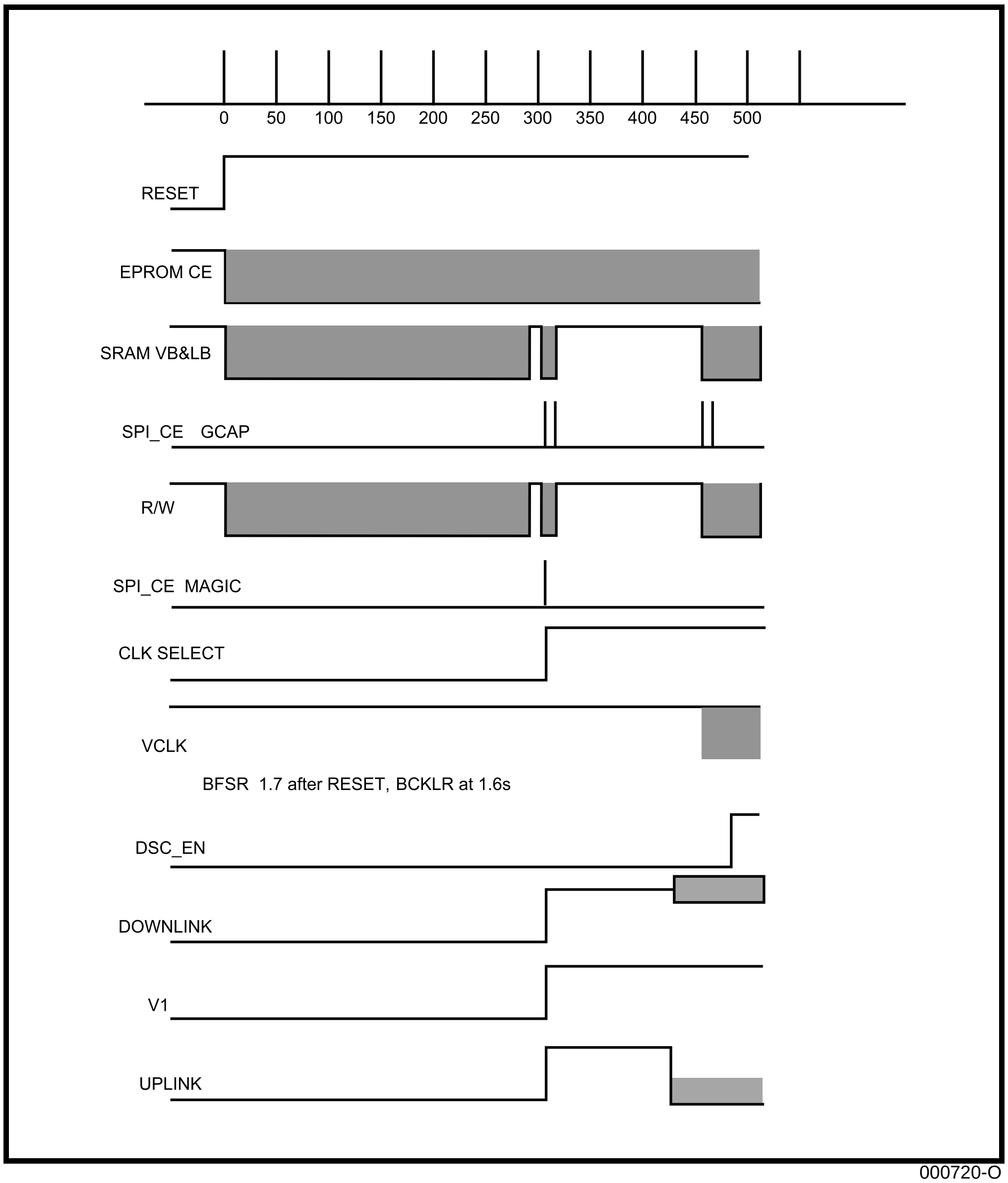


Figure 8. Power-up Sequence Timing Diagram

On initial power up, all the keypad backlights (***DS500*** - ***DS509*** and ***DS512*** - ***DS522***) and display backlights (***DS504*** - ***DS510*** on the antenna board in flip housing) are turned on. They are supported by the signal ALRT_VCC (B+ through ***Q903***) and switched by BKLT_EN (Whitecap IC ***Pin K3***) through ***Q907***.

13 MHz clock. Initially, upon power being applied to the Magic IC, crystal ***Y200*** (supported by CRYSTAL_BASE (Magic IC ***Pin E1***)) emits a 26 MHz signal to the Magic IC. The 26 MHz signal is internally divided by two, to produce the external 13MHz clock. The 13 MHz clock is then fed out of the Magic IC on ***Pin J6*** Magic IC_13MHz and distributed to Whitecap IC ***Pin H10*** CLKIN, then from Whitecap IC ***Pin B7*** to GCAP II ***Pin F5*** as GCAP_CLK. At the same time, 13 MHz varactor Diode ***CR248*** is producing an output. This output is controlled in the following way: The 26 MHz from ***Y200*** is divided down to 200 kHz and fed to a phase comparator within the Magic IC. The 13 MHz from ***CR248*** is also divided down and fed to the phase comparator, the difference in phase producing an error voltage that is fed onto the cathode of varactor ***CR248*** to stabilize the 13 MHz clock. Once the software is running and the logic side of the board has successfully powered-up, the CLK_SELECT signal from Whitecap IC ***Pin A1*** is fed to Magic IC ***Pin G6***. This in turn switches the Multiplexer from the output of ***Y200*** to the output of ***CR248*** (see Figure 9).

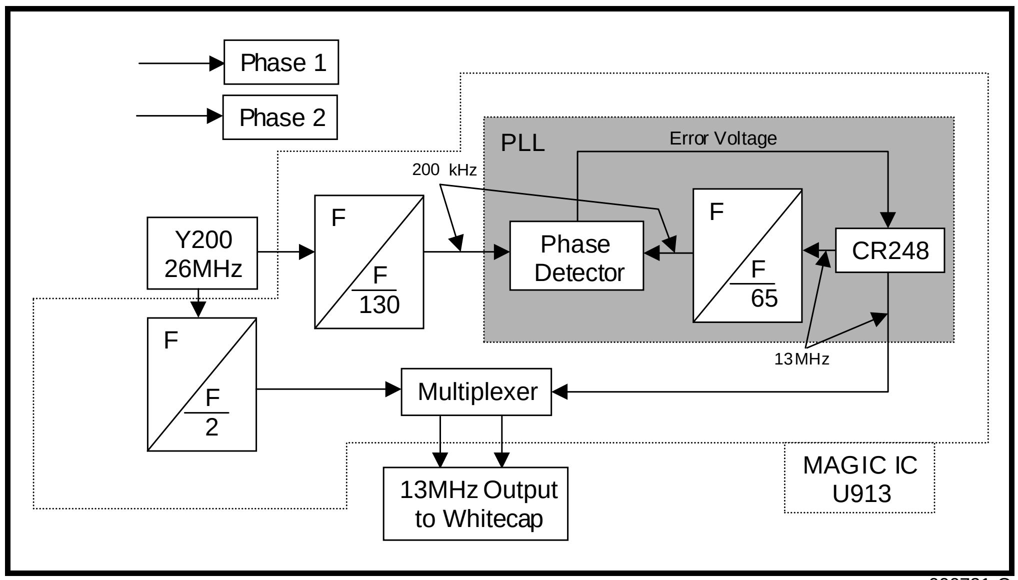


Figure 9. 13 MHz Clock Block Diagram

SIM Card Interface

The SIM interface is part of the Whitecap IC ***U800*** and supports both synchronous (prepay card) and asynchronous serial data transmission. The SIM card is interrogated on power-up. VSIM1 (SIM_VCC) defaults to 3V but, if a 5V card is present the SIM card is powered-down and VSIM1 reprogrammed to 5V. SIM inputs and outputs are level-shifted within ***GCAP II U900*** to 3V. These signals are:

- Reset. Whitecap IC ***Pin E9*** RST0 to GCAP II ***Pin K7*** LS1_IN_TG1A. This signal is level-shifted to the required voltage and fed to SIM contacts ***J803 Pin 2*** from ***Pin J7*** LS1_OUT_TG1A.
- Clock. This is a 3.25MHz signal from Whitecap IC ***Pin E9*** CLK0 [***Pin E7***] to GCAP II ***Pin G6*** LS2_IN. This signal is level-shifted to the required voltage and fed out to SIM Contacts ***J803 Pin 1*** from ***Pin F6*** LS2_OUT.
- SIM I/O. Data transmission to and from SIM card.
  - TX: From SIM card contact SIM I/O ***J803 Pin 6*** through to GCAP II ***Pin J8*** SIM I/O. Level-shifted to desired voltage and out through ***Pin K10***

LS3_TX_PA_B+ to Whitecap IC ***Pin F3*** DAT0_TX.

- RX: Data from Whitecap IC ***Pin B5*** DATA0_RX to GCAP II ***Pin H8*** LS3_RX where the signal is level-shifted to desired voltage and output on ***Pin J8*** SIM I/O to SIM contacts ***J803 Pin 6*** SIM I/O.

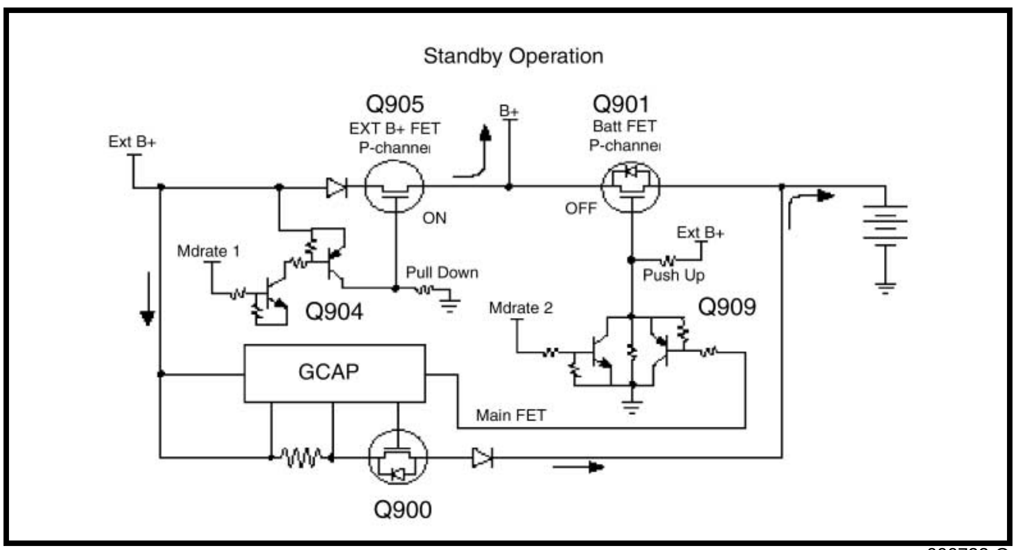
- SIM_PD. From BATT_THERM battery contact. With no batteries present, the unit will not power-up. If batteries are present, but colder than -15° C and no card is inserted, the output of the comparator ***Q905*** stays high and the unit displays INSERT CARD. When the battery temperature is above -15° C (BATT_THERM voltage approximately 2.51V), but the SIM card is either not inserted or faulty, CHECK CARD displays.

Charger Circuit

Either the mid-rate charger or the full rate charger may be used. (See also "Charger Power Source" on page 14.)

In standby, ***Q905*** is opened to provide the approximately 50mA required by the PF38C Personal Communicator circuitry. ***Q900*** also opens, controlled by CHRGC (GCAP II ***Pin E8***) to provide a charge of 350mA to the battery. The charger is capable of supplying the 400mA of current required to support the Personal Communicator in standby while, at the same time, charging its internal battery. Charging current is monitored at GCAP II ***Pin D9*** I_SENSE by monitoring the voltage drop across current sense resistor ***R913***.

In standby, MIDRATE_1 = 0 and MIDRATE_2 = 0



000722-O

Figure 10. Standby Operation Battery Charging

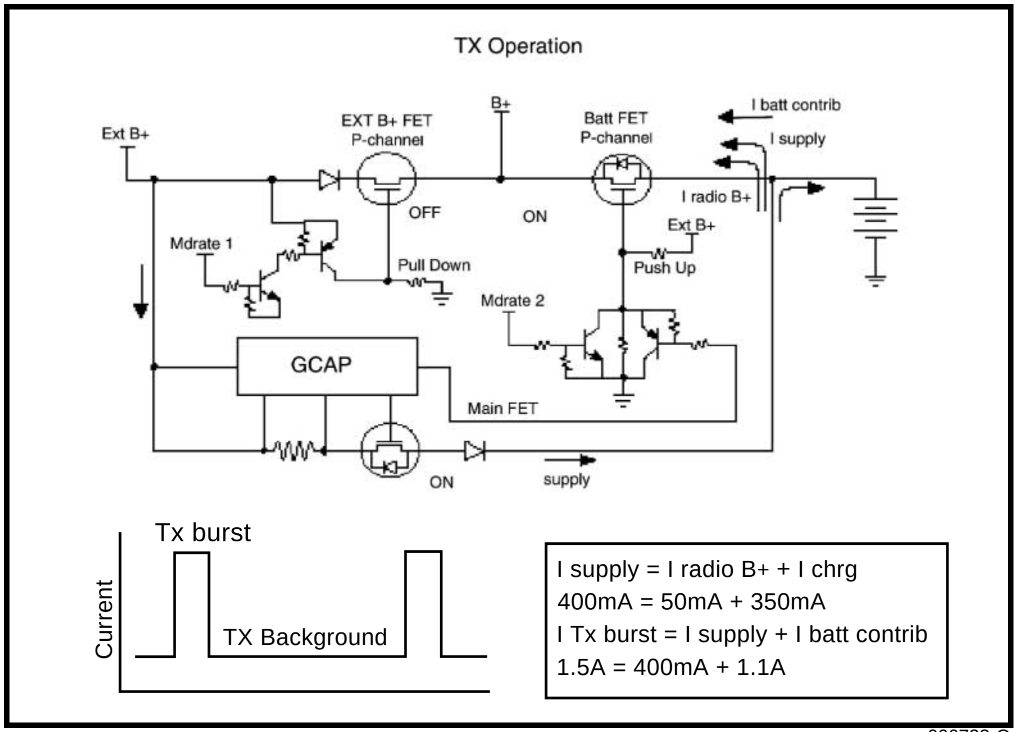


Figure 11. Transmit Operation Battery Charging

In TX background mode the Communicator requires the same current as in standby mode, with 50mA supporting the unit and 350mA charging the battery. During TX background, however, the EXT B+ FET ***Q905*** is switched off causing the charger current to be directed through the charging FET ***Q900***.

In TX background, MIDRATE_1 = 0 and MIDRATE_2 = 1

During transmission, the communicator requires up to 1.5A to be supplied during each burst. During a TX pulse the full 400mA from the charger supports B+ in addition to approximately 1.1A from the battery.

In TX burst, MIDRATE_1 = 1 and MIDRATE_2 = 1

Deep Sleep Mode

Deep sleep mode saves battery life by intermittently shutting off part of the PCB as follows: STBY_DL is generated from Whitecap IC ***Pin F1***, through a standby delay circuit consisting of diode ***CR912*** and logic gate ***U906*** which provides a short delay between activation of STBY_PC5 and STBY_DL. This is a hardware patch for timing issues related to the Whitecap IC's deep sleep module (DSM). The resulting signal is passed onto ***Q911*** and ***Q912*** which, in turn:

- Grounds VREF, making Magic IC inoperable.
- Grounds V2, switching off Magic IC, Front END IC and inhibits the Transmit path through RF_V2.

Deep sleep mode shutdown is only for a fraction of a second and, during that time, the GCAP Clock supports the logic side of the unit. The GCAP clock is generated by ***Y900***, which generates a 32.768 MHz clock. This clock is output from GCAP Pin ***C7*** and fed directly to Whitecap IC Pin ***P4***. The clock is always monitored by Whitecap IC and should it fail, the unit is prevented from going into deep sleep mode.

Keypad Interface

The keypad interface consists of five row and five column pins. The rows are inputs and the columns can be configured either as inputs or outputs by setting bit 5 of the COL_CONTROL register (1 = input, 0 = output).

When operating with columns as inputs, any active row or column signal will result in an interrupt. The active state (high or low) for columns and rows can be selected by setting bit 2 of the COL_CONTROL and ROW_CONTROL respectively.

In this product, the keys are active low. (The front keys and the PCB artwork keys use a three contact design.) One of the contacts is tied to ground while the other two are connected to the row and column inputs. When a key is pressed all three of its pads are shorted and therefore grounded. Each key is uniquely distinguished by the two lines pulled low. No strobing of the keypad is necessary.

Table 4. Keypad Mapping

Function	Key	KBR0	KBR1	KBR2	KBR3	KBR4	KBC0	KBC1	KBC2	KBC3	KBC4
A	S509	0									0
B	S508	0								0	
C	S507	0							0		
D	S506	0						0			
E	S505	0					0				
F	S504	0				0					
G	S503	0			0						
H	S502	0		0							
I	S501	0	0								
J	S517		0								0
K	S515		0							0	
L	S515		0						0		
M	S514		0					0			
N	S513		0				0				
O	S512		0			0					
P	S511		0		0						
Q	S510		0	0							
R	S524			0							0
S	S523			0						0	
T	S522			0					0		
U	S521			0				0			
V	S520			0			0				
W	S519			0		0					
X	S518			0	0						
Y	S530				0						0

Table 4. Keypad Mapping (Continued)

Function	Key	KBR0	KBR1	KBR2	KBR3	KBR4	KBC0	KBC1	KBC2	KBC3	KBC4
Z	S529				0					0	
Comma	S528				0				0		
Period	S527				0			0			
?	S526				0		0				
ALT	S525				0	0					
Colon	S534					0					0
Shift	S533					0				0	
Fast Access	S548					0			0		
Smart	S532					0		0			
Voice Notes	S531					0	0				
Left	S538						0				0
Right	S537						0			0	
Up	S536						0		0		
Down	S535						0	0			
Menu	S541							0			0
Space	S539							0		0	
Ok/Enter	S540.S545							0	0		
Mail	S543								0		0
Cancel	S542								0	0	
Editor	S547									0	0

Display

The display is a [64 X 126] pixel graphics display and is connected to the PCB via a 27 Pin ZIF connector ***J902***. The display is made up of glass with polarizers, a display driver and transflector. It is [connected to the antenna PCB through a heat seal connector. The LCD is controlled by:

- CS1 Chip Select which originates from DP_EN_L, Whitecap IC ***Pin A11*** to ***J902 Pin 1***.
- RES which originates from RESET, Whitecap IC ***Pin P2*** to ***J902 Pin 2***.
- R/W which originates from R_W, Whitecap IC ***Pin B11*** to ***J902 Pin 4***.
- 8 Data Lines from Whitecap IC DO - D7
- The display is supported by V2 and -10V (originating from ***U904*** and can be measured on ***C965***)
- The data/command signal AO from Whitecap IC ***Pin B12***.

Vibrator

Vibrator ***M1*** is reflowed to the bottom side of the Controller board. The vibrator is controlled by the signal VIB_EN Whitecap IC ***Pin K1*** and B+ through ***U501***.

Troubleshooting

Tools and Test Equipment

The following tables list the tools and test equipment used on the Product Family 38C Personal Communicator. Use either the listed items or equivalents.

Table 5. Specific Test Equipment

Motorola Model Number	Equipment Type	Application
SPN4604A	Rapid Charger[1]	Used to charge battery and power device
SPN4858A	GSM RAE RJ45 BP w/CDA[1]	Device to PC interface (uses rapid charger for power)
8102430Z04	GSM/DCS Test SIM[1]	Used during manual test mode

1. To order, contact Motorola Aftermarket and Accessories Division at (847)538-8000.

Table 6. General Test Equipment

Motorola Model Number	Equipment Type	Application
6662894B35	Radial UMP Connector Extraction Tool [1]	Used to disconnect the coaxial cable from the transceiver circuit board
RSX4043-A	Torque Driver[1]	Used to remove and replace screws
	Torque Driver Bit T-6 Plus, Apex 440-6IP Torx Plus or equivalent[1]	Used with torque driver
6680388B67	Disassembly tool, plastic with flat and pointed ends[1]	Used during assembly/disassembly of device
6680388B01	Delrin Tweezers[1]	Used during assembly/disassembly
HP46103Y	8922 GSM Gate System[2] or	Used to test and troubleshoot device
HP46103Y + #P26	8922 GSM Gate System w/ optional Spectrum Analyzer[2] or	
CMD-P22	GSM Gate System[3]	
HP3630A	Power Supply[2]	Used to provide power to device
HP34401A	Digital Multimeter[2]	Used to troubleshoot device

1. To order, contact Motorola Aftermarket and Accessories Division at (847)538-8000.
2. Not available from Motorola. To order, contact Hewlett Packard at 1-800-452-4844.
3. Not available from Motorola. To order, contact Rohde & Schwarz at www.rsd.de.

Table 6. General Test Equipment (Continued)

Motorola Model Number	Equipment Type	Application
HP54600A	Digital Oscilloscope[2]	Used to troubleshoot device
HP9595E	Spectrum Analyzer[2]	Optional. Used to troubleshoot device
SKN4858A	EMMI Box, GSM RAE RJ45 BP[1]	Used to program Whitecap

1. To order, contact Motorola Aftermarket and Accessories Division at (847)538-8000.
2. Not available from Motorola. To order, contact Hewlett Packard at 1-800-452-4844.
3. Not available from Motorola. To order, contact Rohde & Schwarz at www.rsd.de.

GSM Test Commands

Table 7. GSM Test Commands

Test Command	Test Function/Name
Press and hold # for 2 seconds	Enter manual test mode
01#	Exit manual test mode
07#	Mute RX audio path
08#	Unmute RX audio path
09#	Mute TX audio path
10#	Unmute TX audio path
15xx#	Generate tone
16#	Mute tone generator
19#	Display software version number of Call Processor
20#	Display software version number of Modem
36# *or* 36x#	Initiate acoustic loopback
37#	Stop test
38#	Activate SIM
39#	Deactivate SIM
43x#	Change audio path
47xx#	Set audio volume
51#	Enable sidetone
52#	Disable sidetone
57#	Initialize non-volatile memory
58#	Display security code
58xxxxxx#	Modify security code
59#	Display lock code
59xxx#	Modify lock code
60#	Display IMEI
993#	Display all display pixels
98xx#	Change GSM mode (primary access code)
20#	GSM 1800*
21#	GSM 900*
22#	GSM 1900 (PCS)*
23#	Dual Band 900/1800*
15xx#	Change Alert Mode (primary access code)
90#	Change to Vibrator Mode*
91#	Change to Ringer Mode*
36x#	Change Data Rate (primary access code)
0 or Omitted	Full Rate*
1	Enhanced Full Rate*
2	Half Rate*

*Note: To access these options, you must first type the primary access code.

Programming - Software Upgrade and Flexing

Contact your local technical support engineer for information about equipment and equipment setup for flashing and flexing.

An Emmi2D box (or above) is required for flashing.

Troubleshooting Charts

After initial fault isolation, this section provides component level troubleshooting flowcharts for fault isolation to discrete or integrated components.

Table 8. Flowchart Summary

Fault	Figure	Page
General Test Sequence	12	28
Device Will Not Receive GSM Signals	15	31
Device Will Not Receive DCS/PCS Signals	16	32
No Receiver Control Matrix	17	33
No Receiver VCO	18	34
Device Will Not Transmit	19	35
Low Transmitter Power	21	37
No Transmitter Control Matrix	22	38
PIN Diode Band Select	23	39
Receiver VCO Band Select	24	40
Device Will Not Power Up	25	41
No Ring Tone	27	43
No Audio	28	44
Headset Microphone Not Functioning	29	45
No Display	30	46
Real Time Clock Not Functioning	31	47
Check Card	32	47
No Power Up Using Battery	33	48
Device Draws Current When Powered Off	34	48
Frequency Error	35	49
No Charger	36	50
Keypad Not Functioning	37	51
Voice Recognition/Annotation Not Functioning	38	51
VibraCall® Not Functioning	39	52

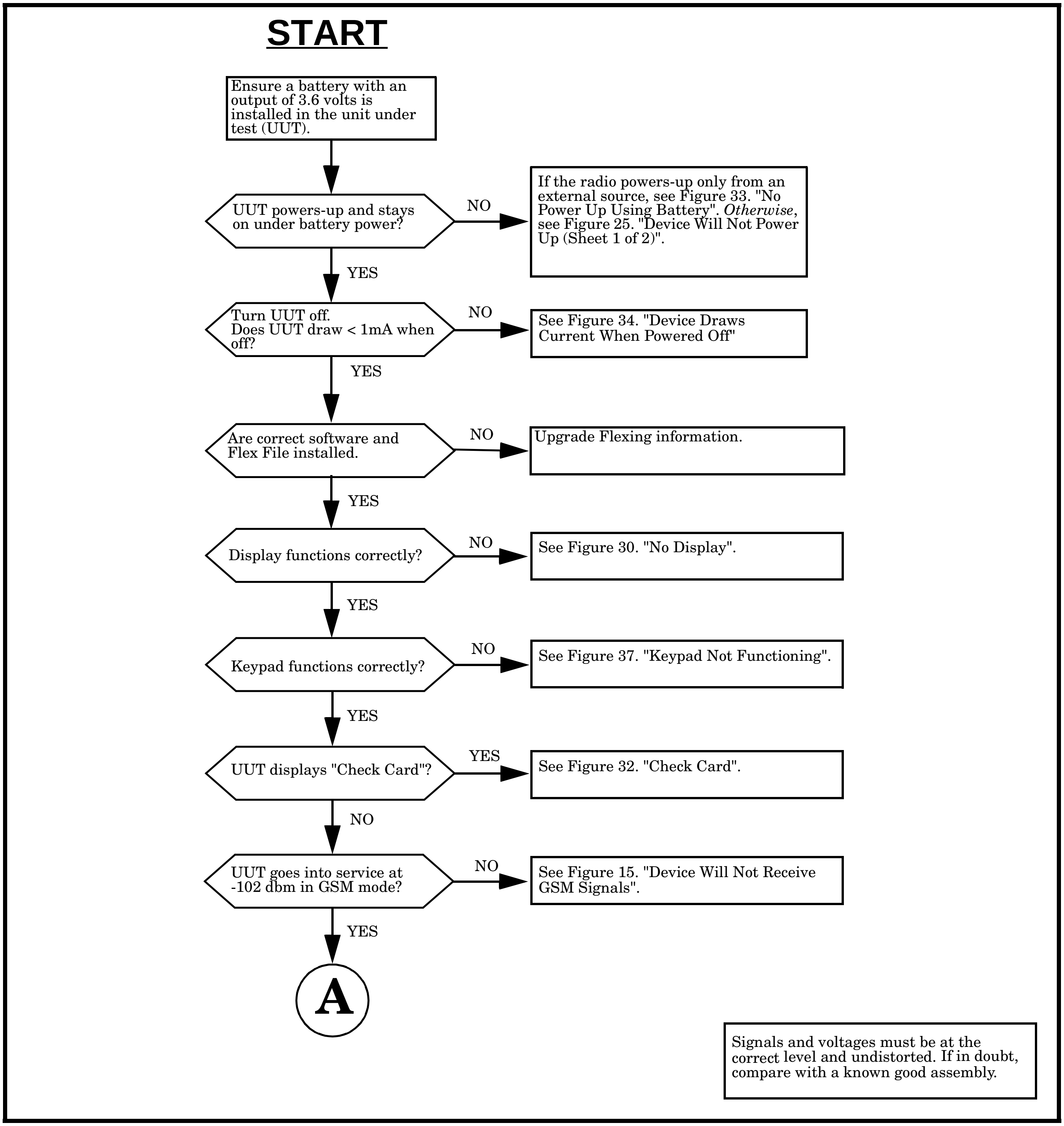


Figure 12. General Test Sequence (Sheet 1 of 3)

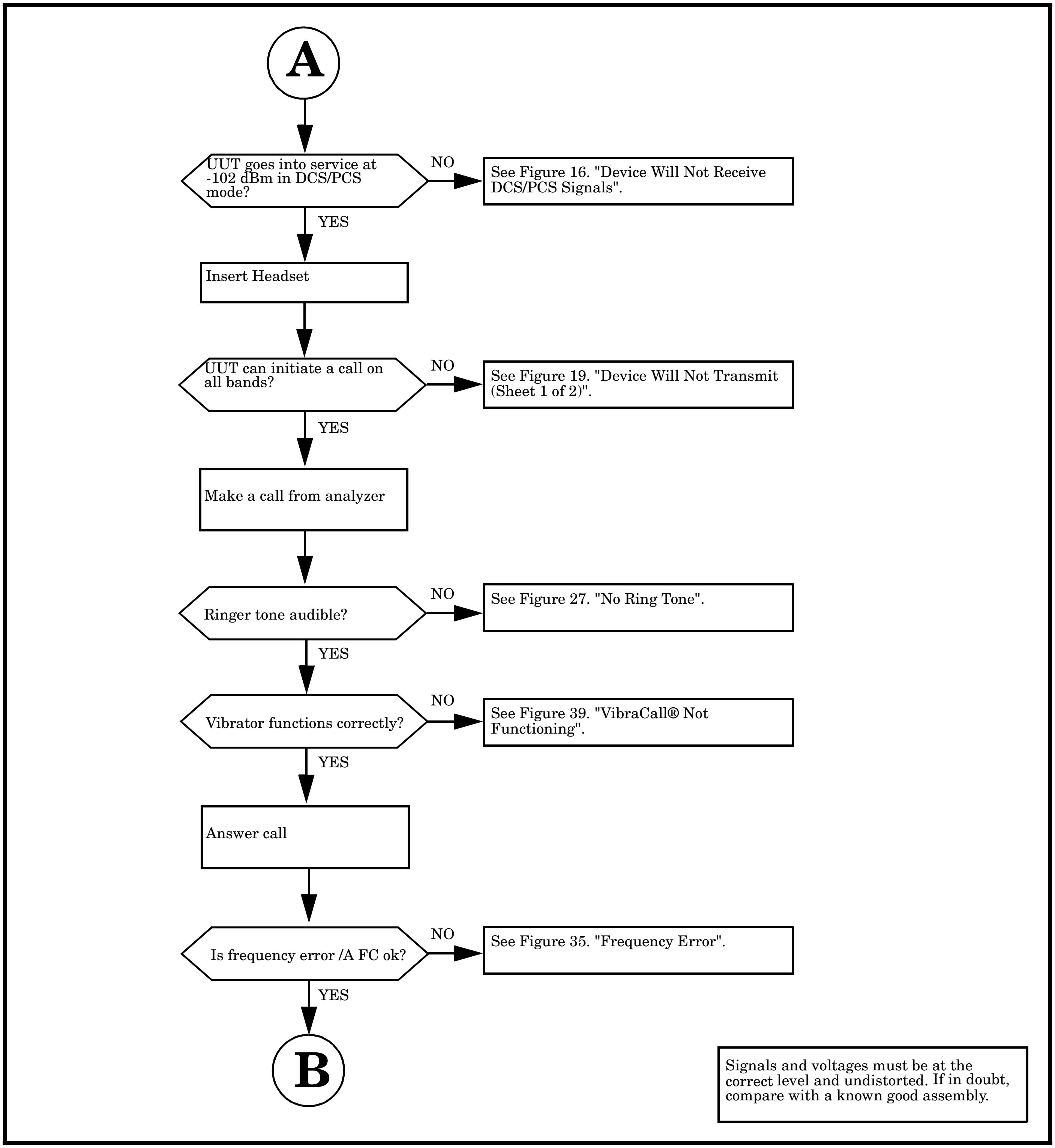


Figure 13. General Test Sequence (Sheet 2 of 3)

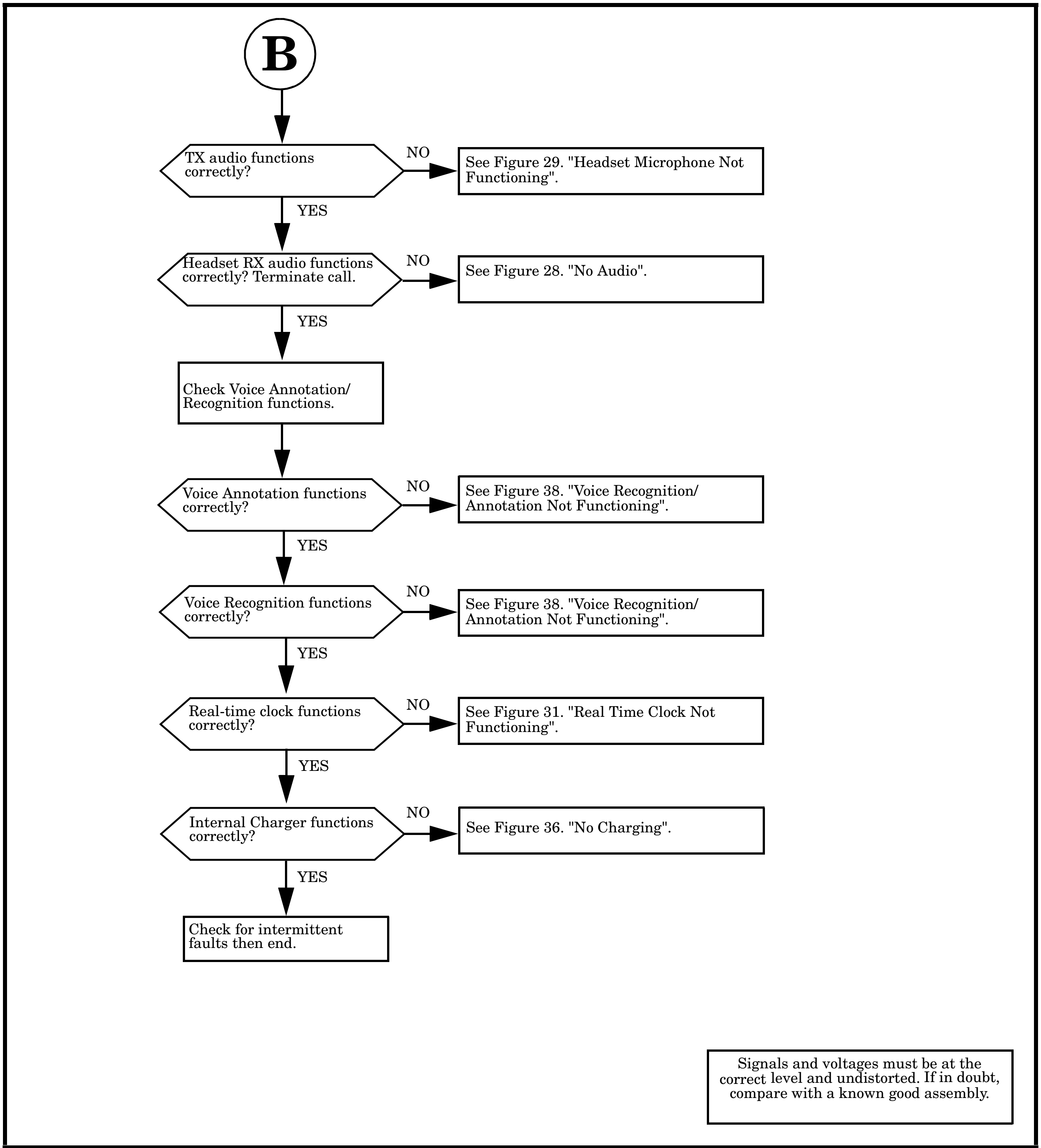


Figure 14. General Test Sequence (Sheet 3 of 3)

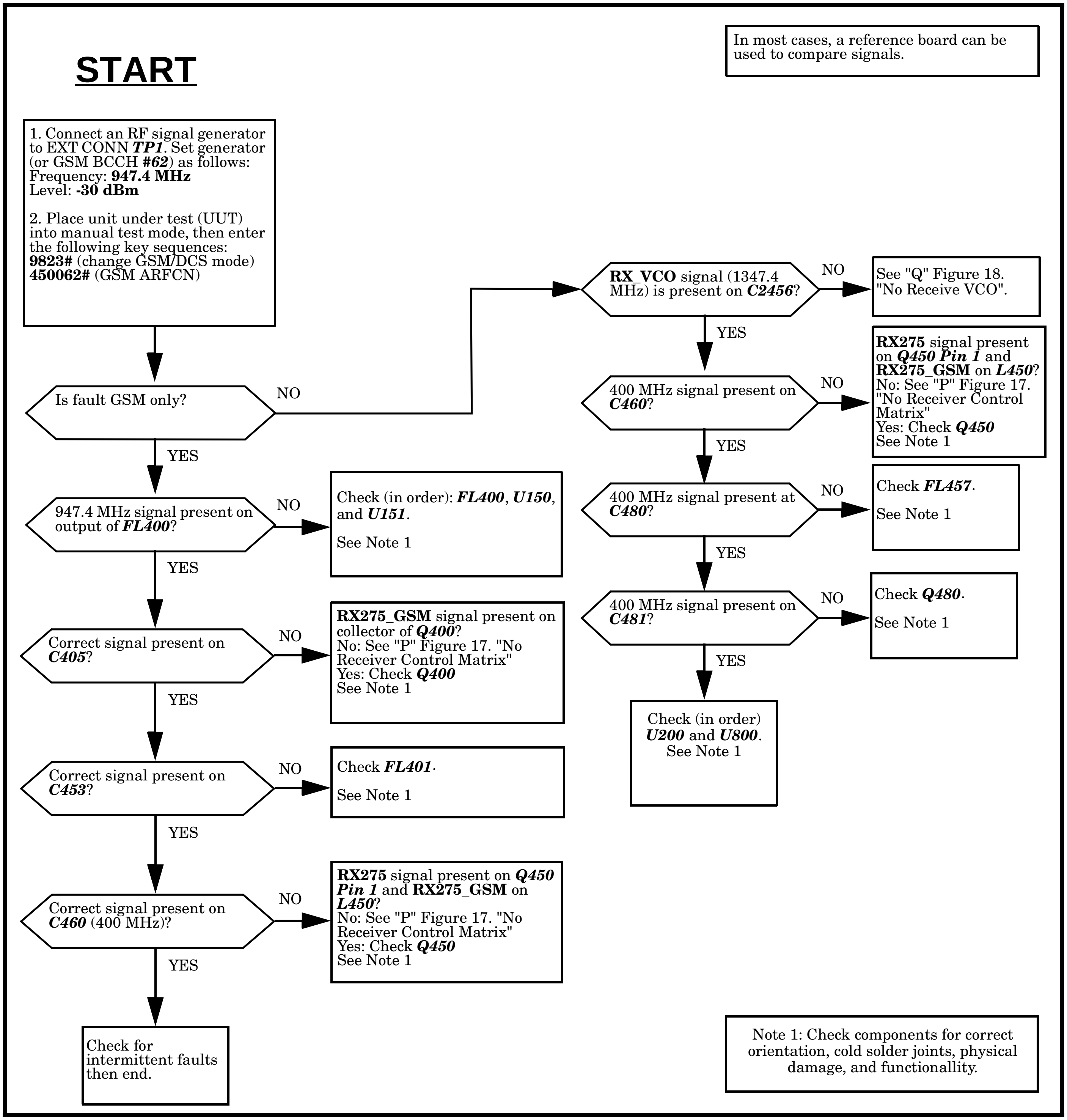


Figure 15. Device Will Not Receive GSM Signals

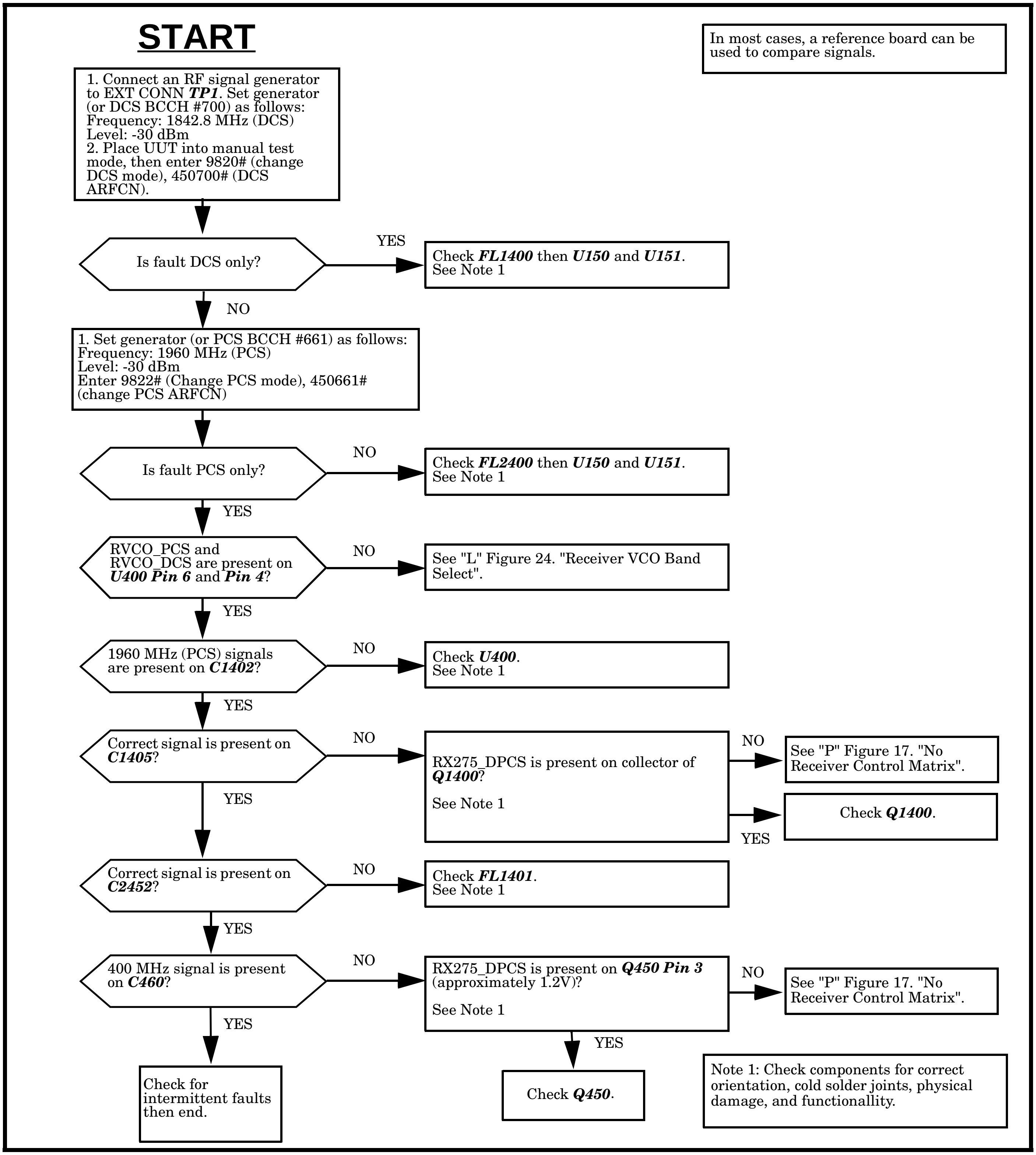


Figure 16. Device Will Not Receive DCS/PCS Signals

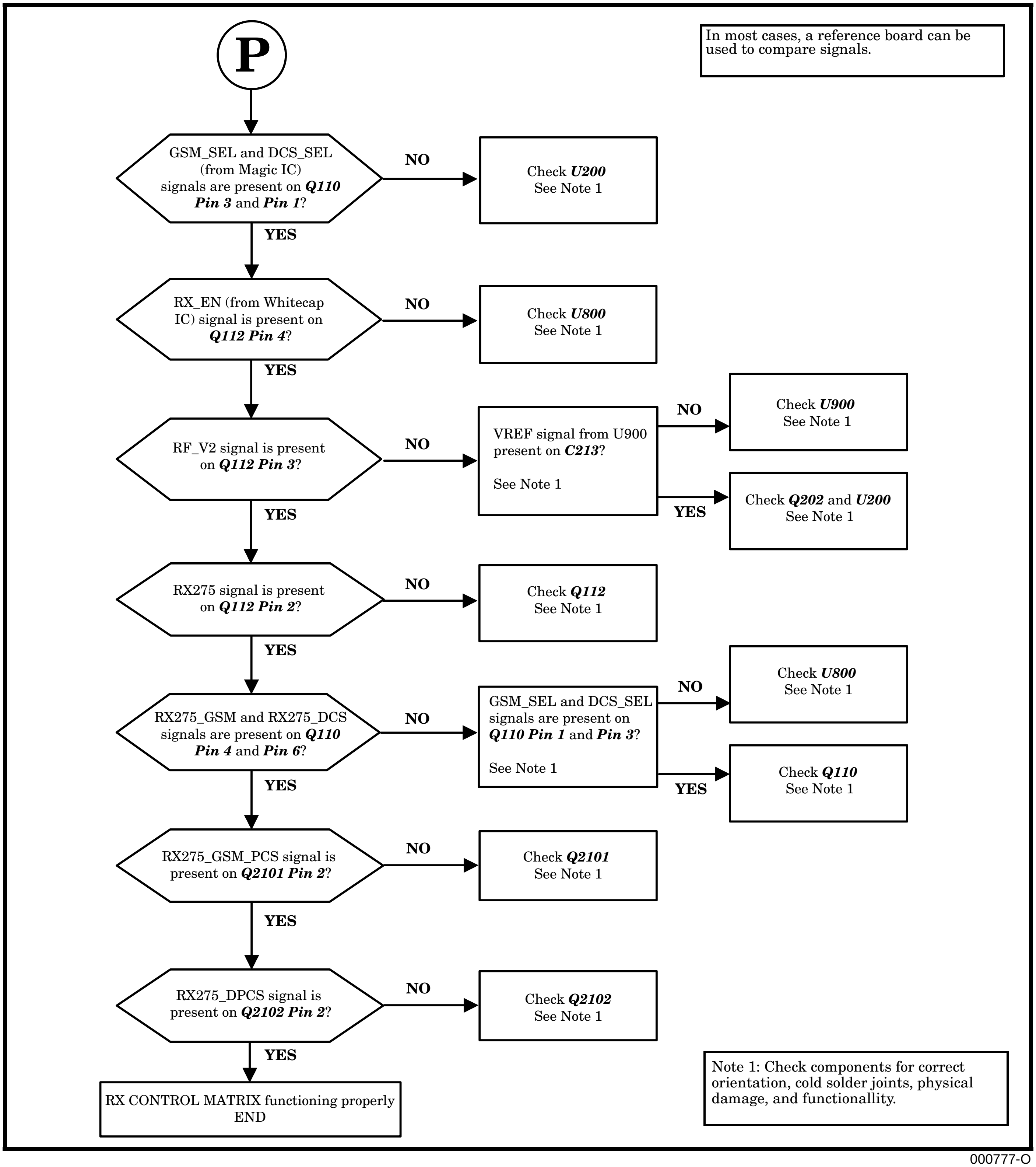


Figure 17. No Receiver Control Matrix

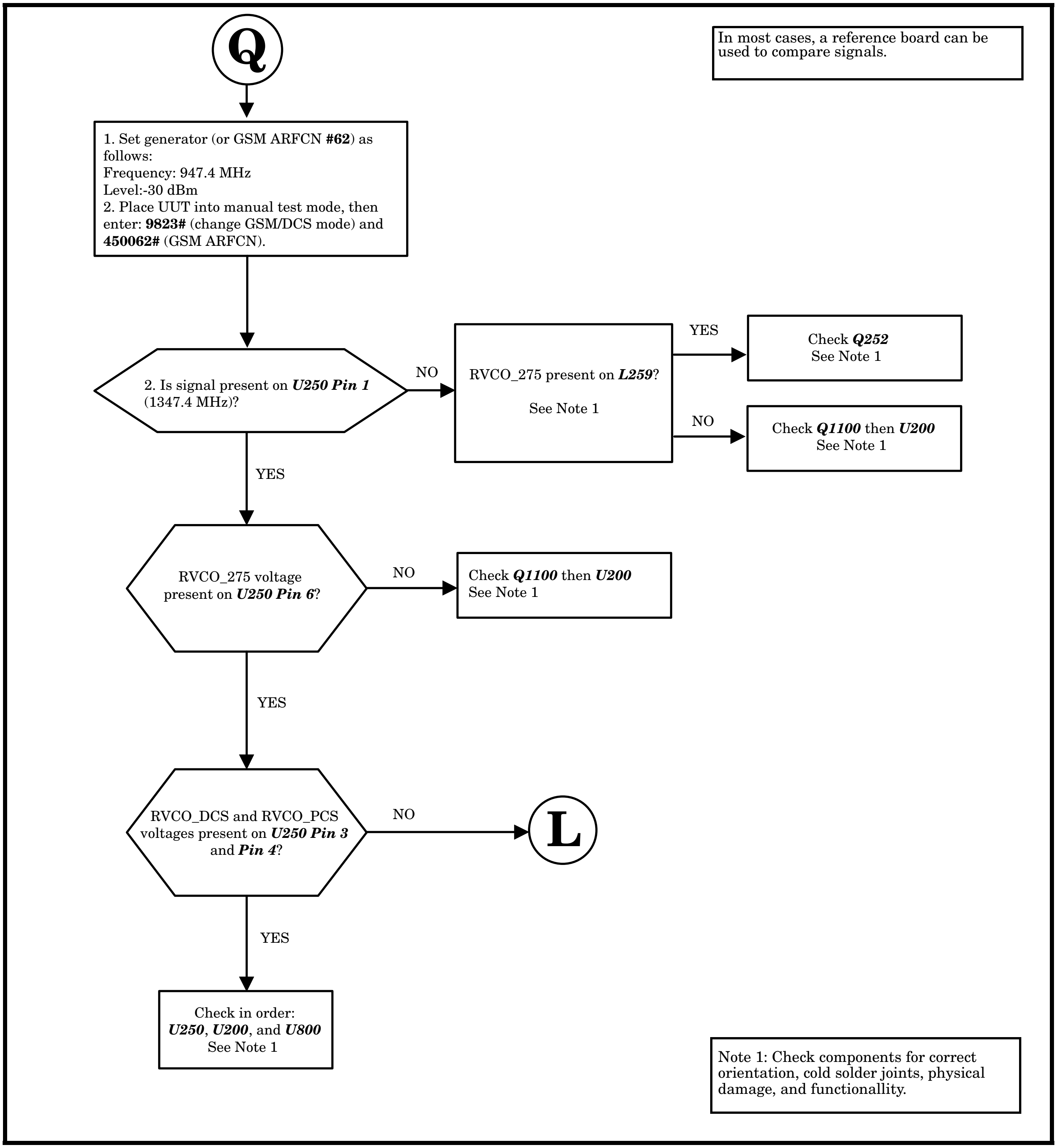


Figure 18. No Receive VCO

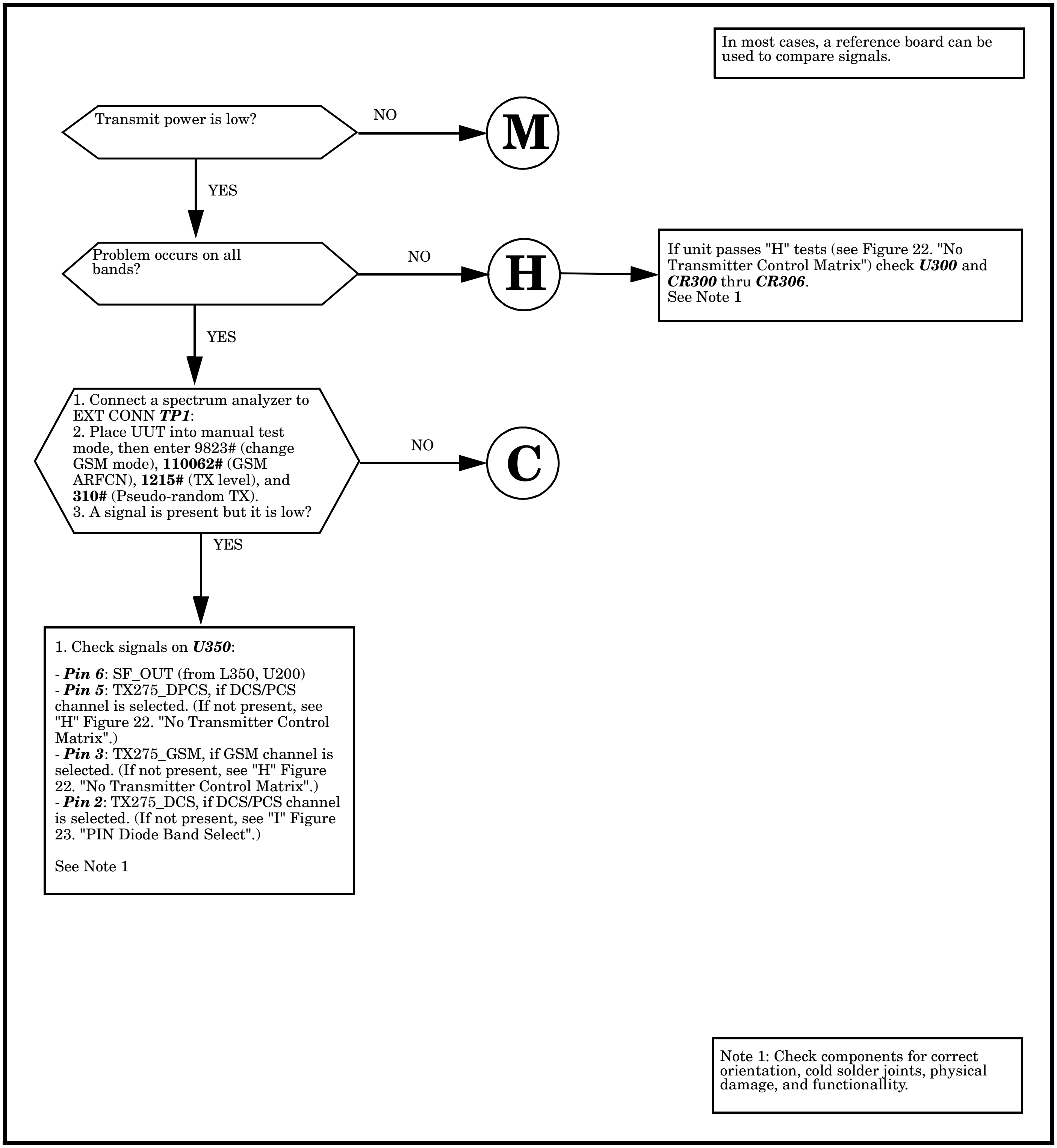


Figure 19. Device Will Not Transmit (Sheet 1 of 2)

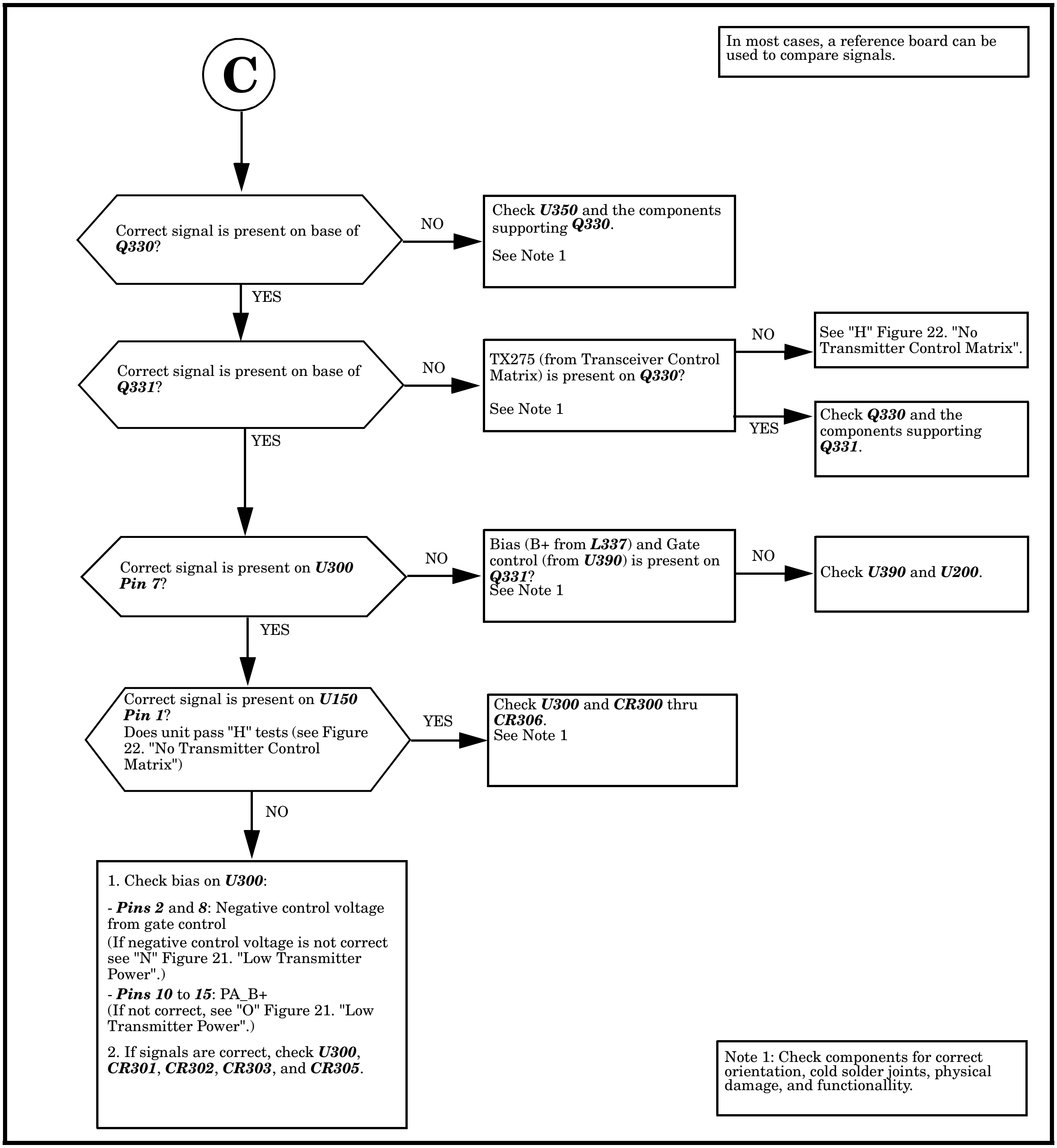


Figure 20. Device Will Not Transmit (Sheet 2 of 2)

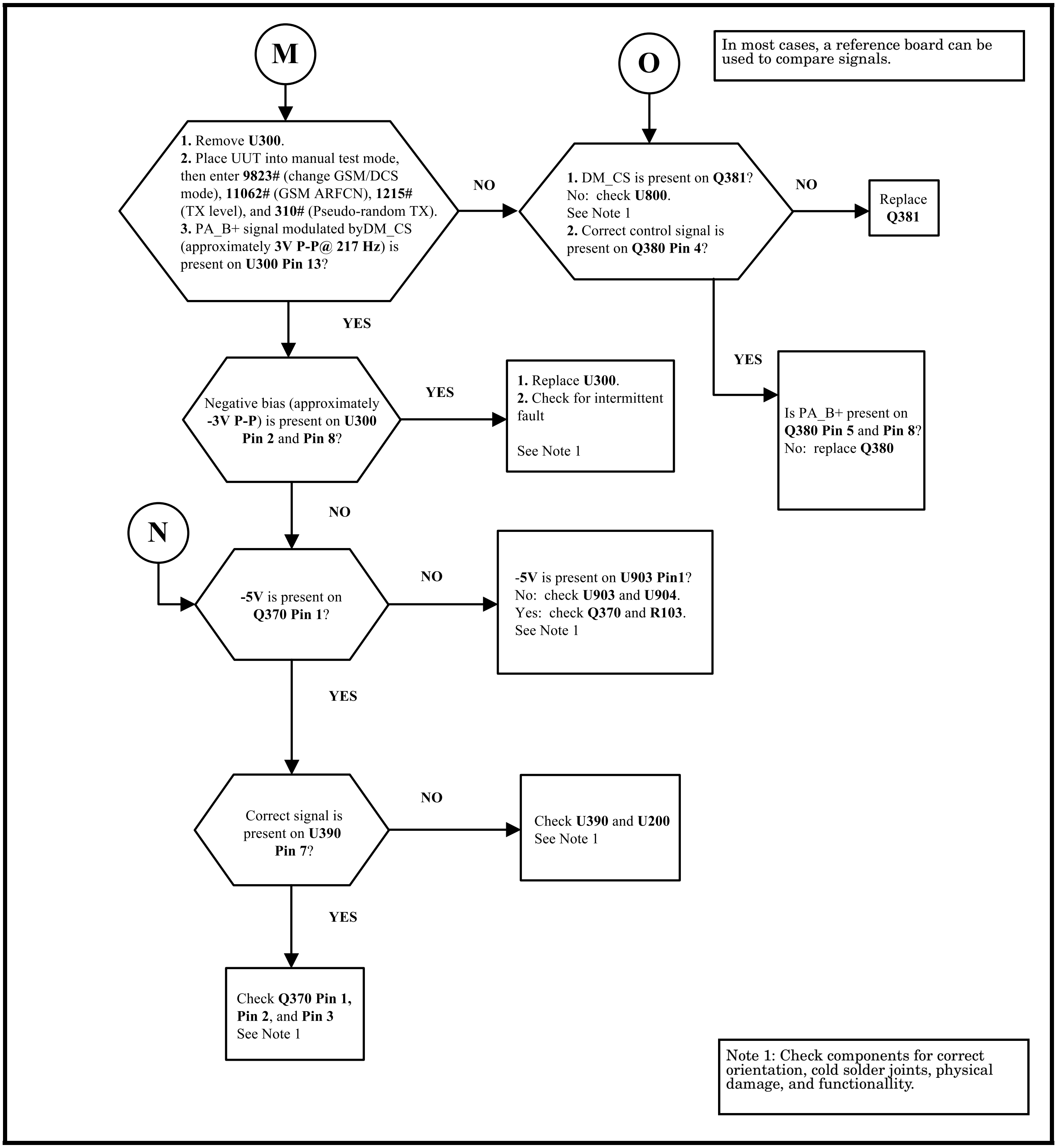


Figure 21. Low Transmitter Power

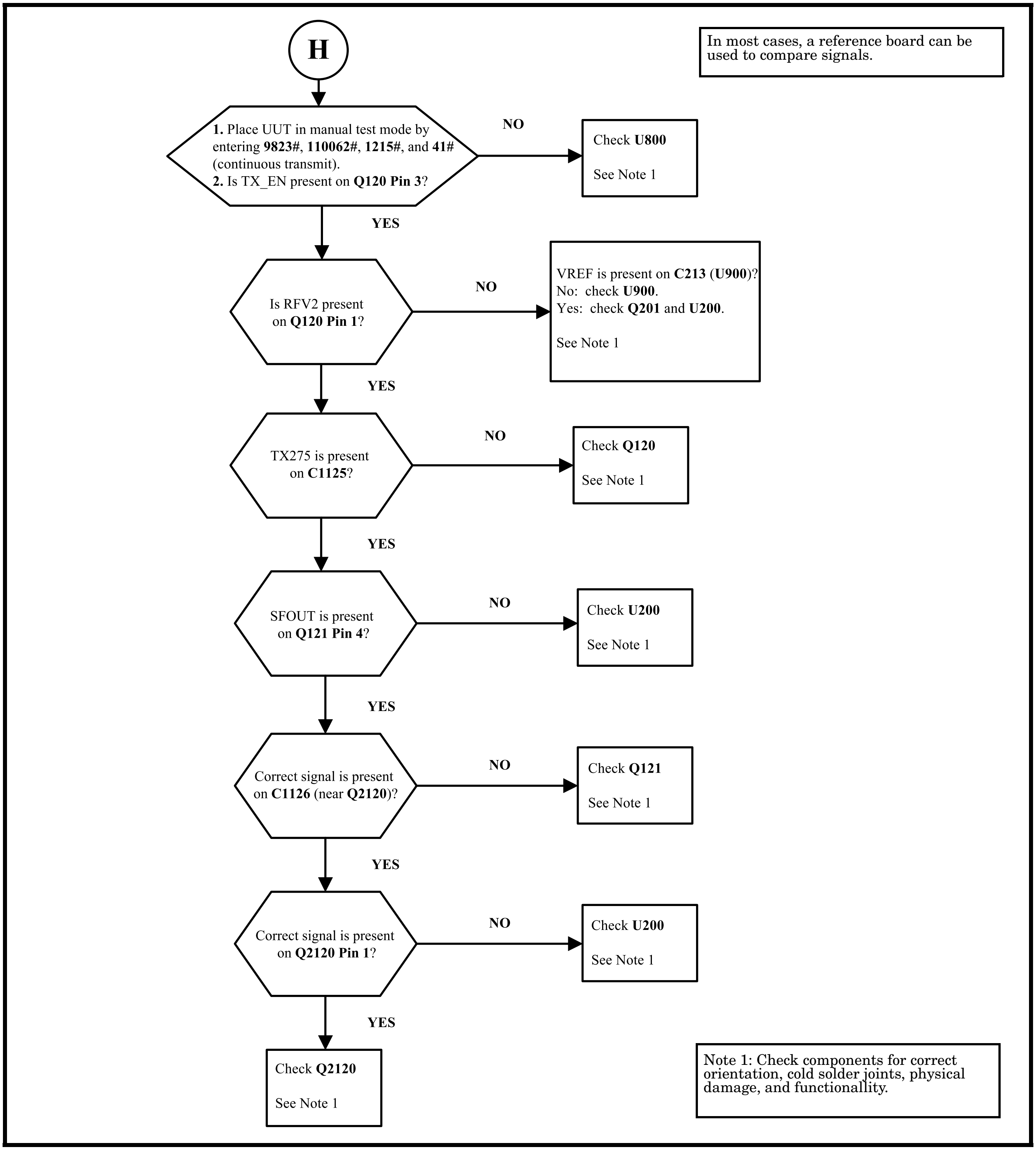


Figure 22. No Transmitter Control Matrix

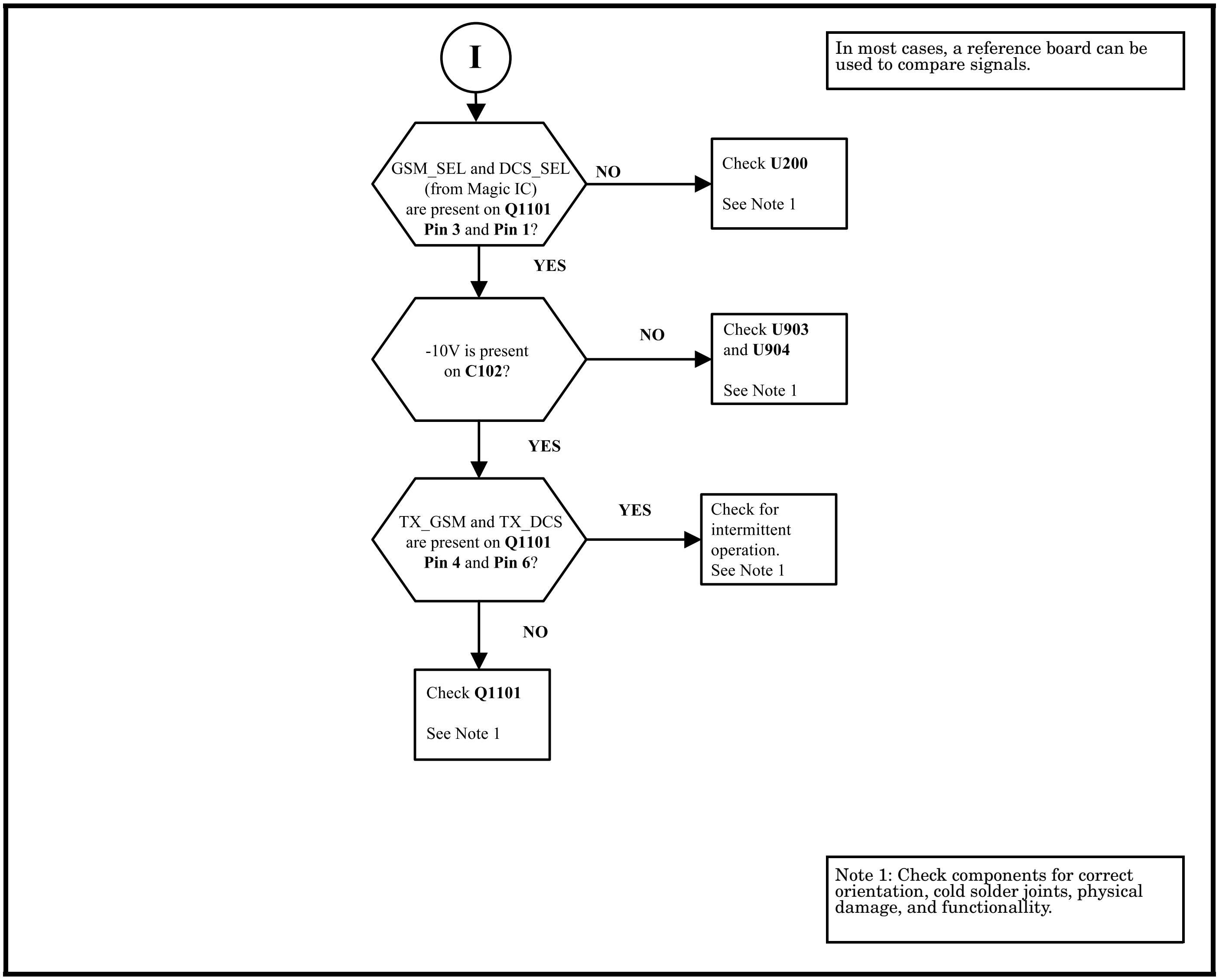


Figure 23. PIN Diode Band Select

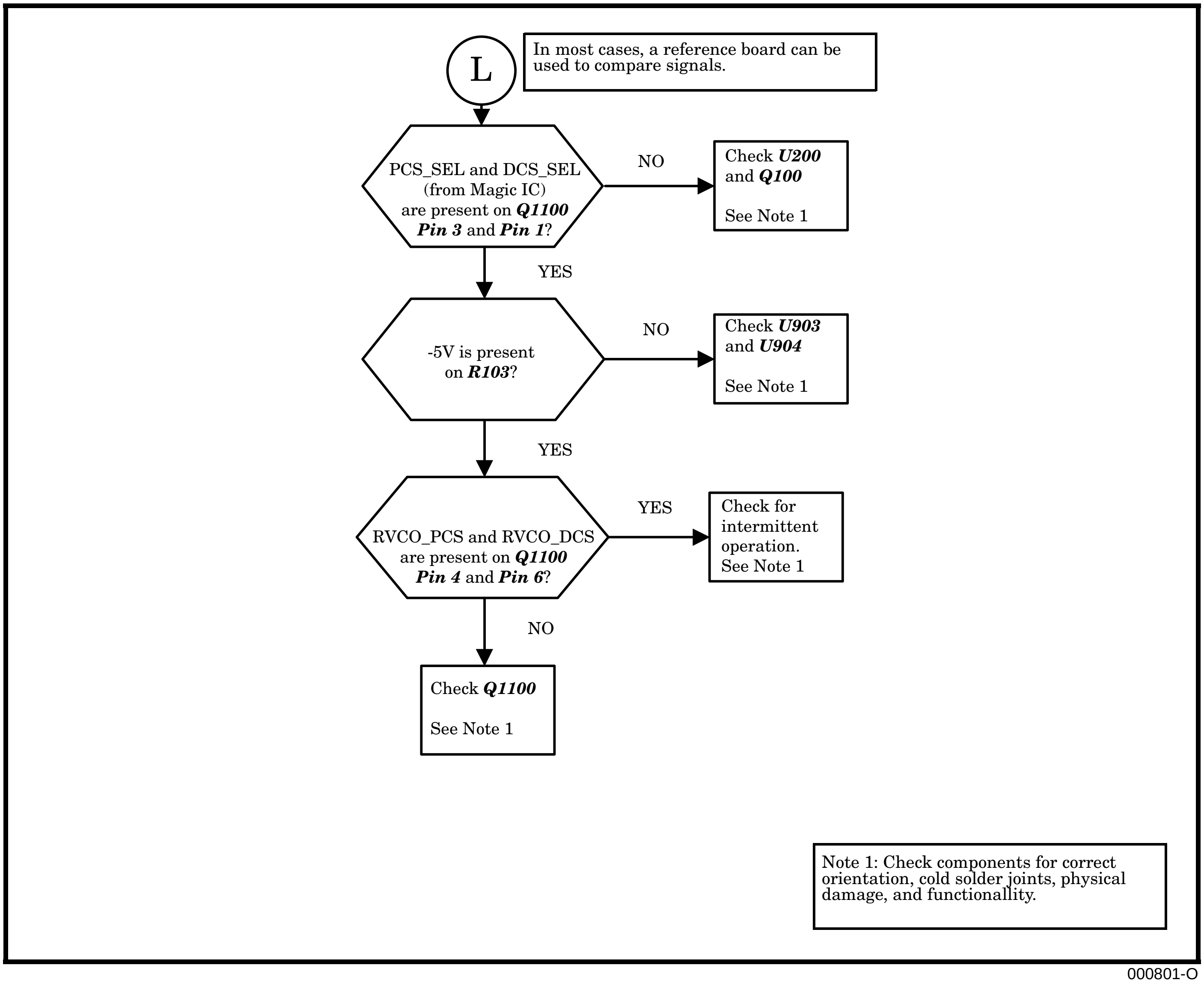
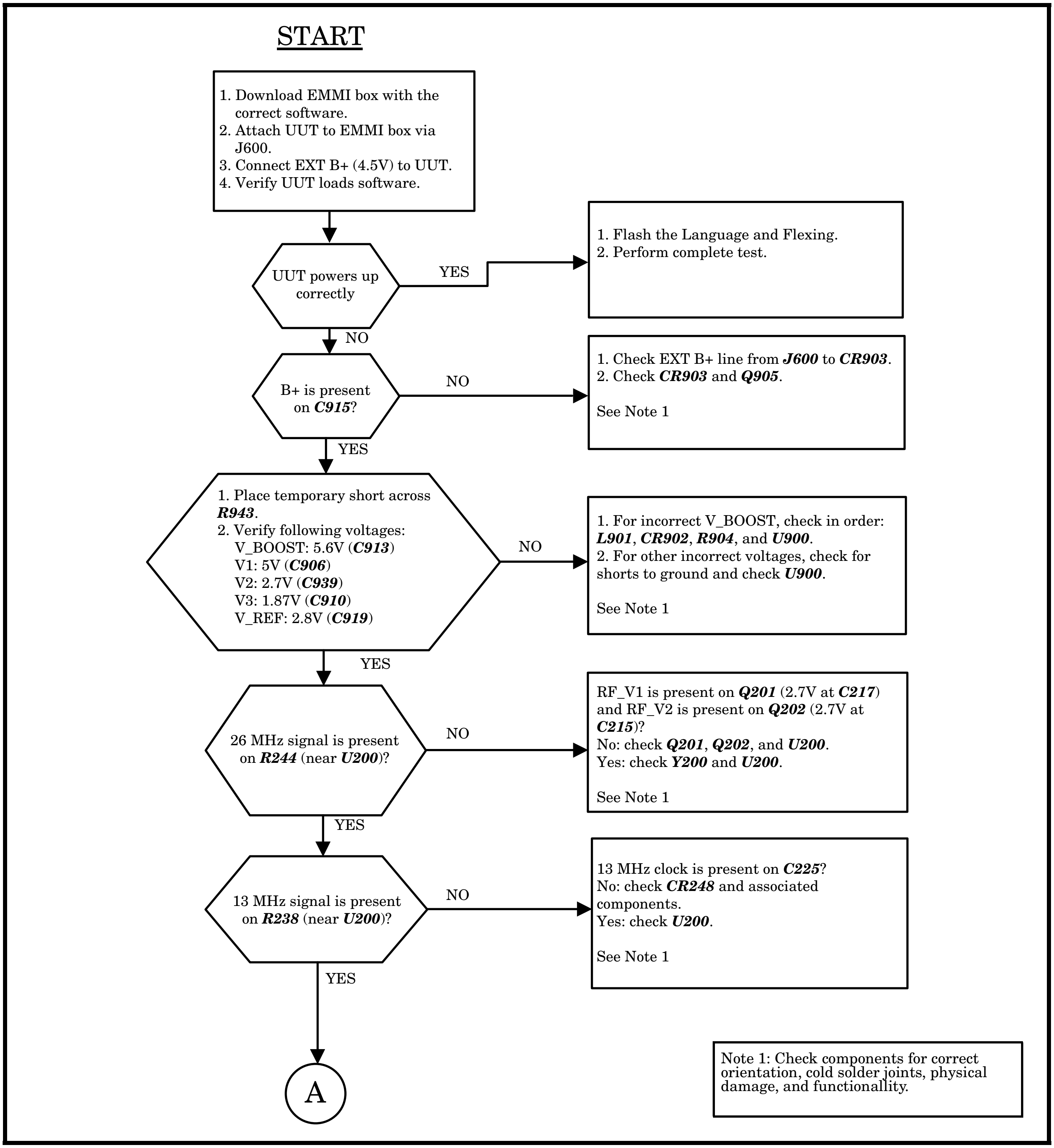


Figure 24. Receiver VCO Band Select



000784-O

Figure 25. Device Will Not Power Up (Sheet 1 of 2)

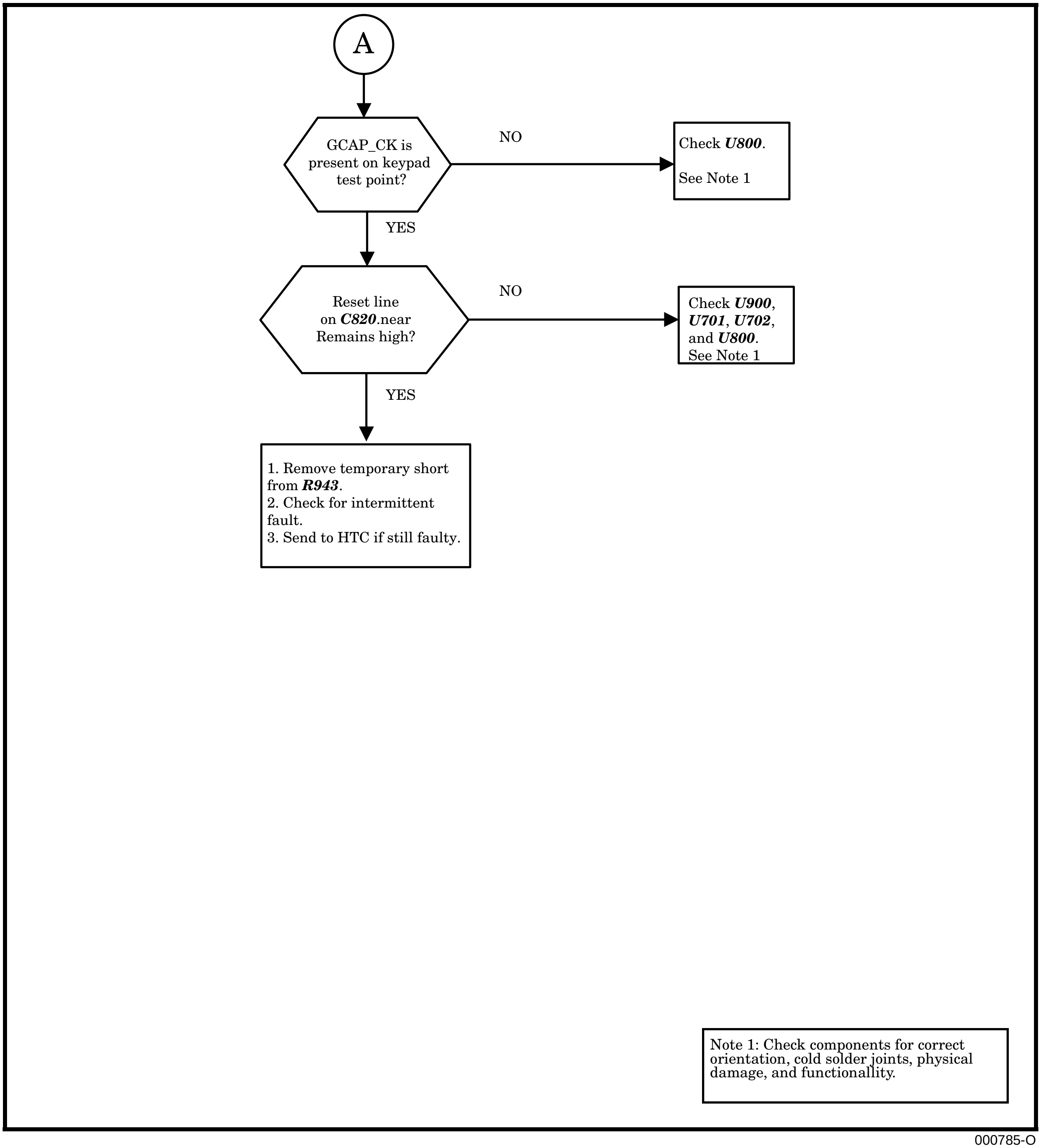
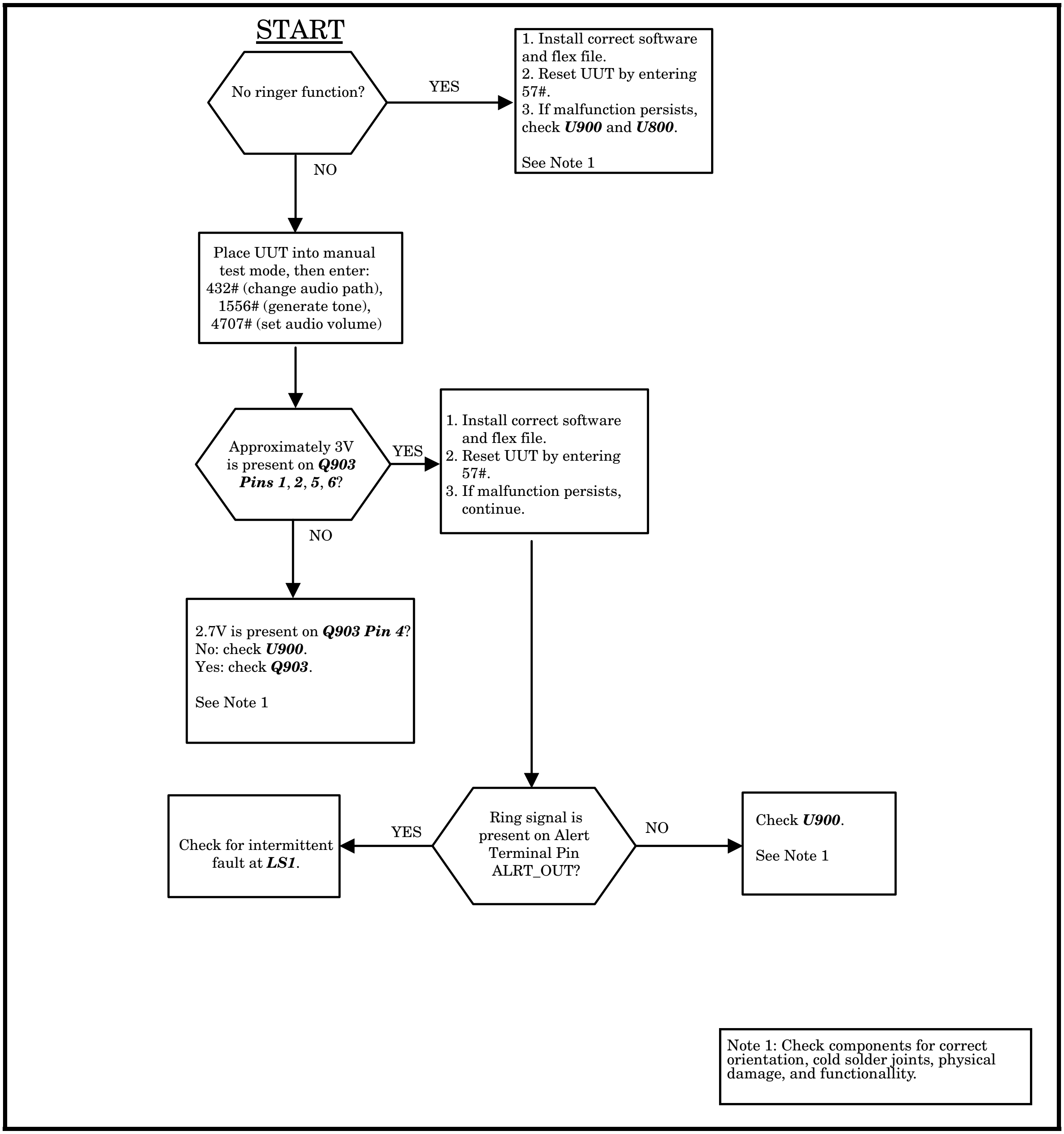
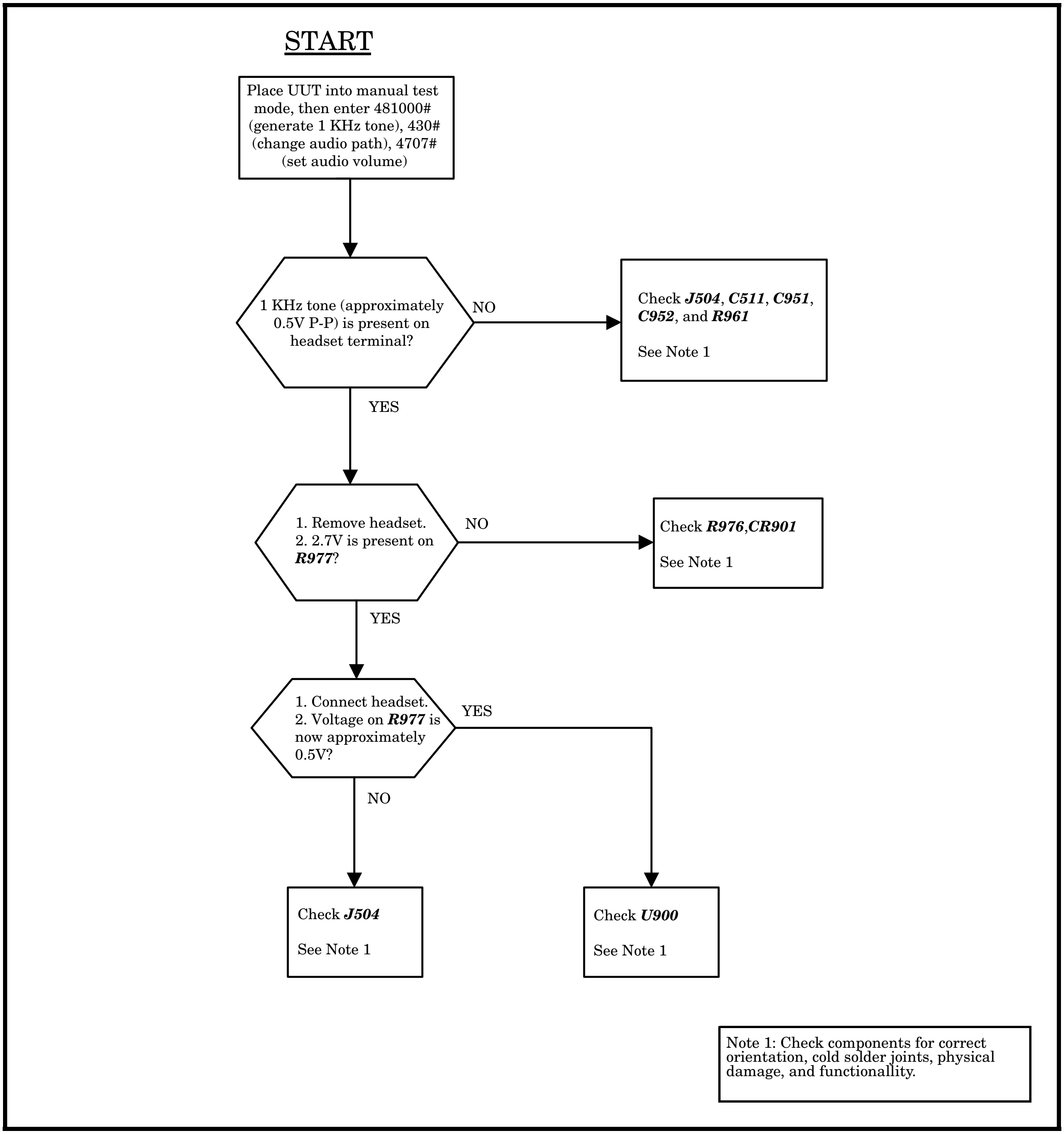


Figure 26. Device Will Not Power Up (Sheet 2 of 2)



000786-O

Figure 27. No Ring Tone



000787-O

Figure 28. No Audio

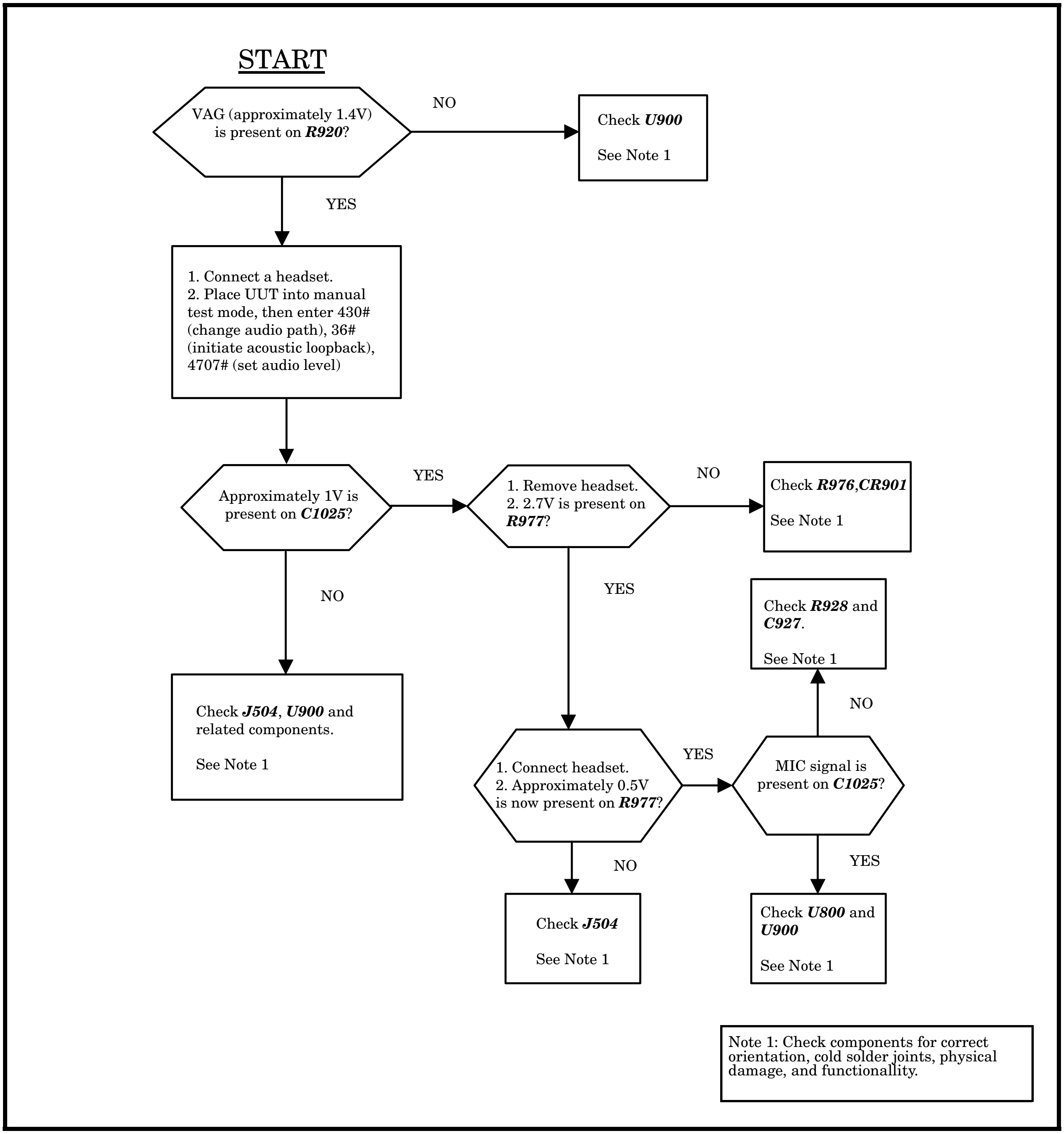
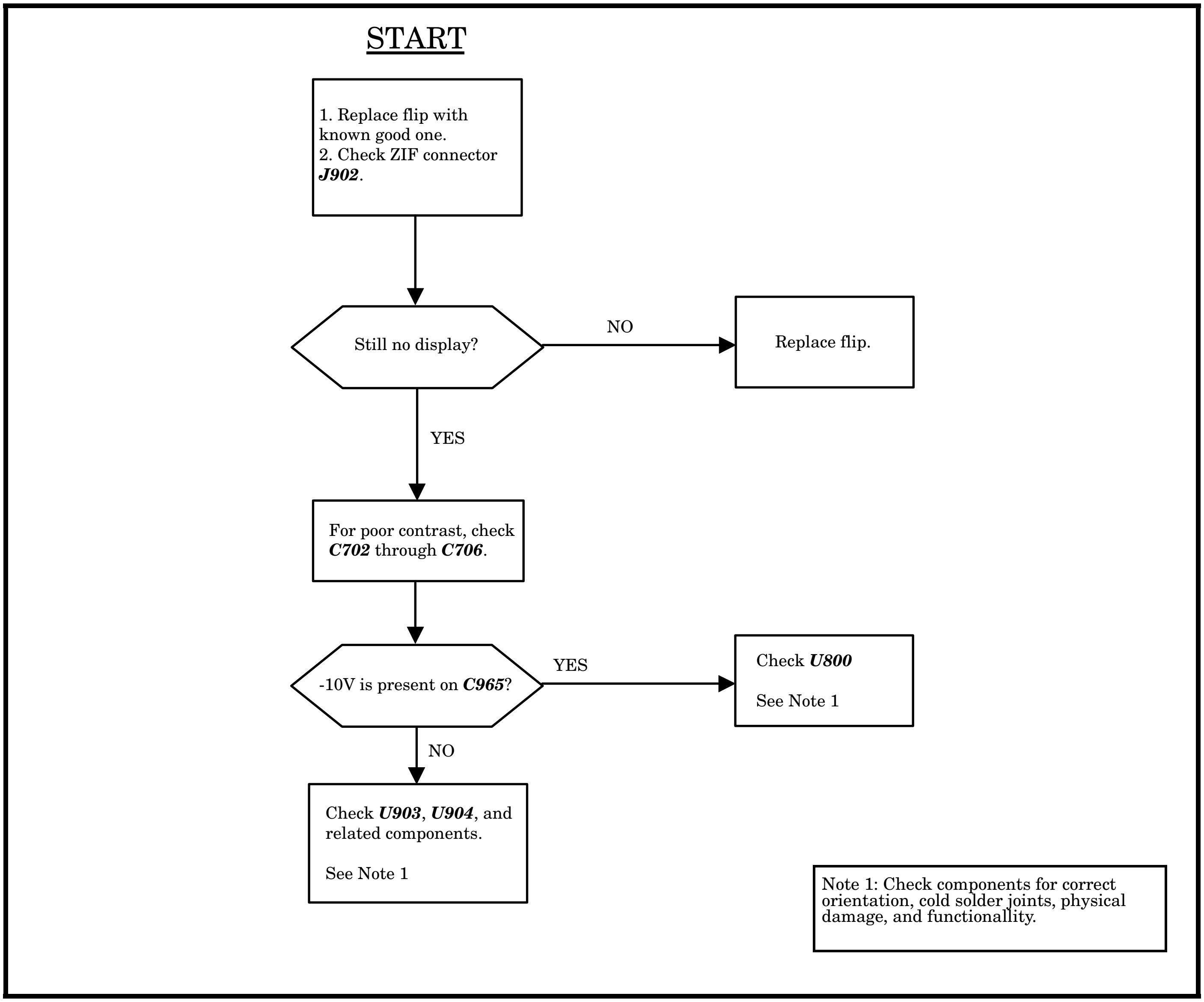
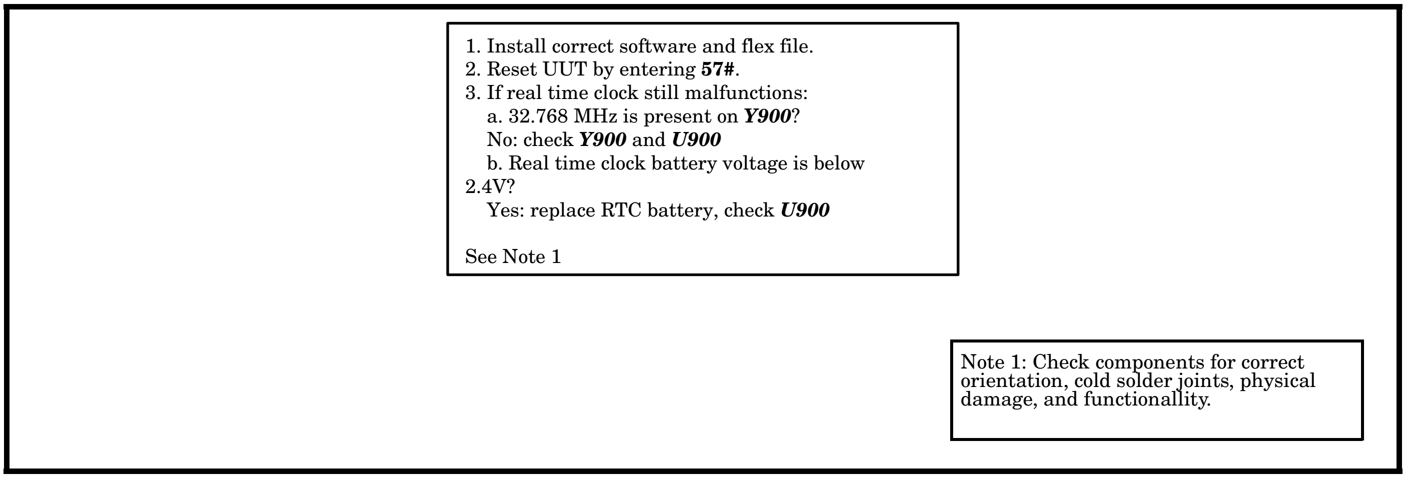


Figure 29. Headset Microphone Not Functioning



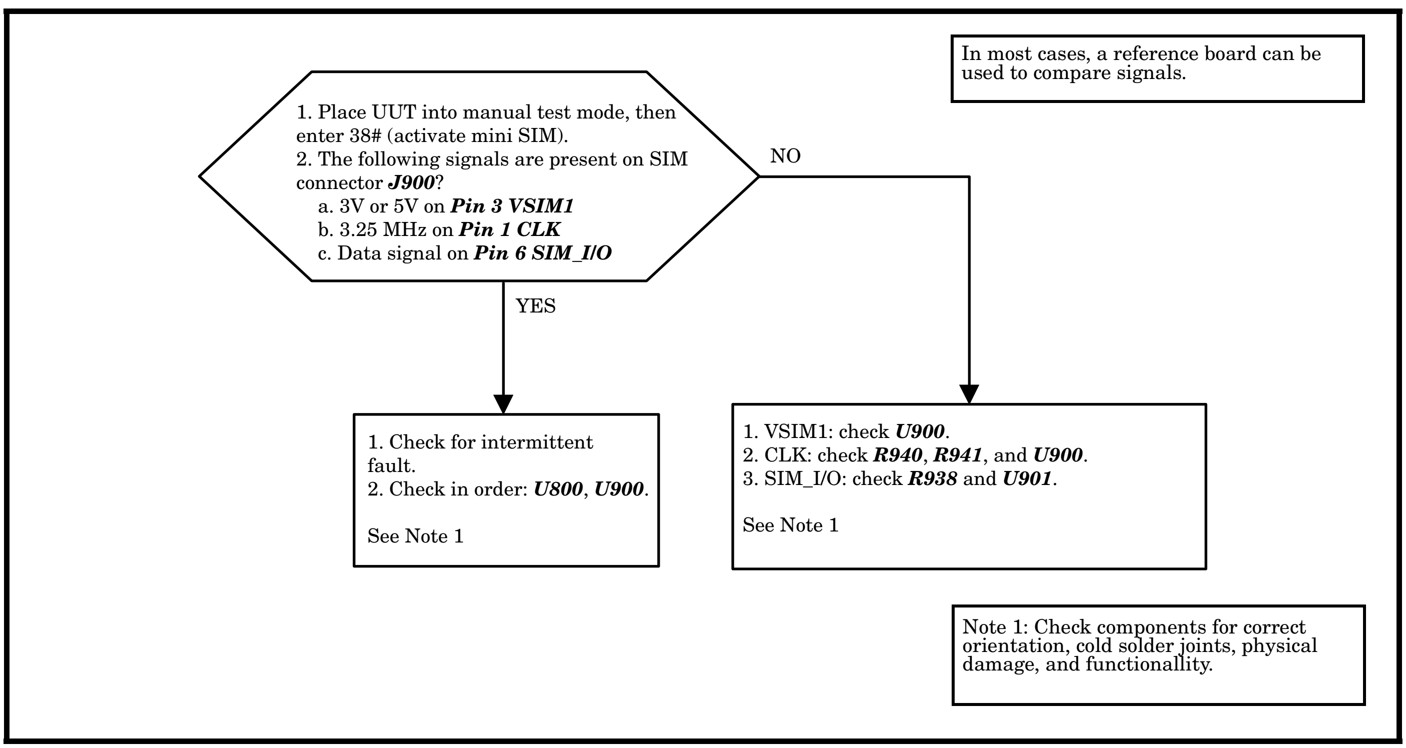
000789-O

Figure 30. No Display



000791-O

Figure 31. Real Time Clock Not Functioning



000793-O

Figure 32. Check Card

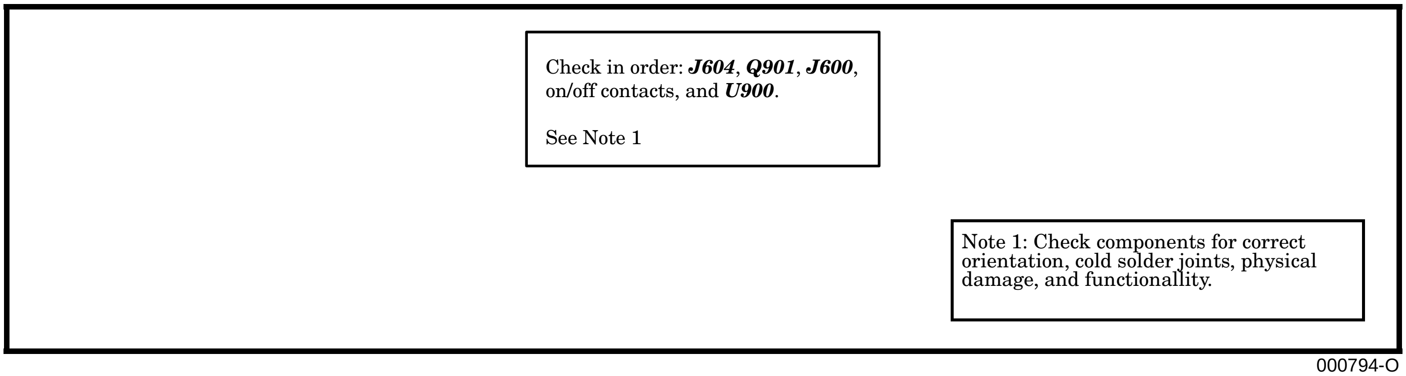


Figure 33. No Power Up Using Battery

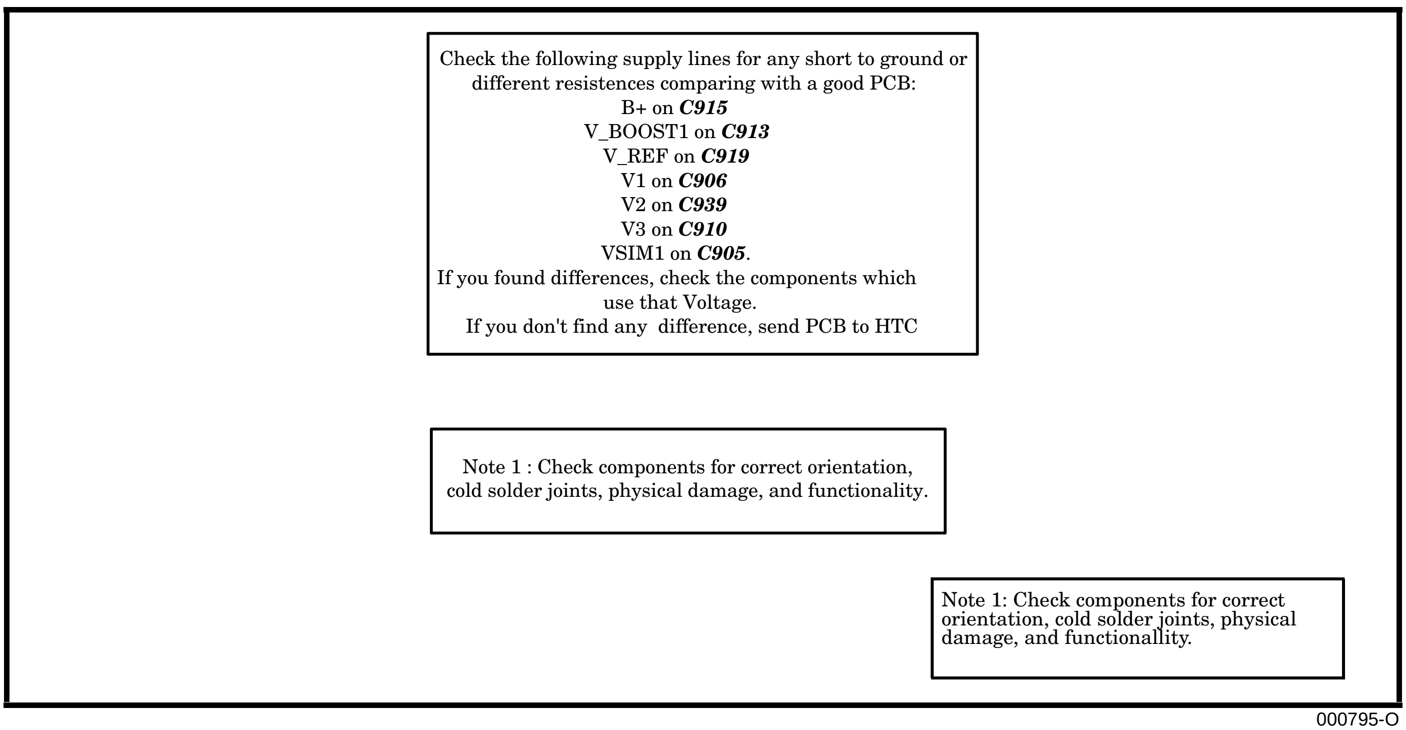


Figure 34. Device Draws Current When Powered Off

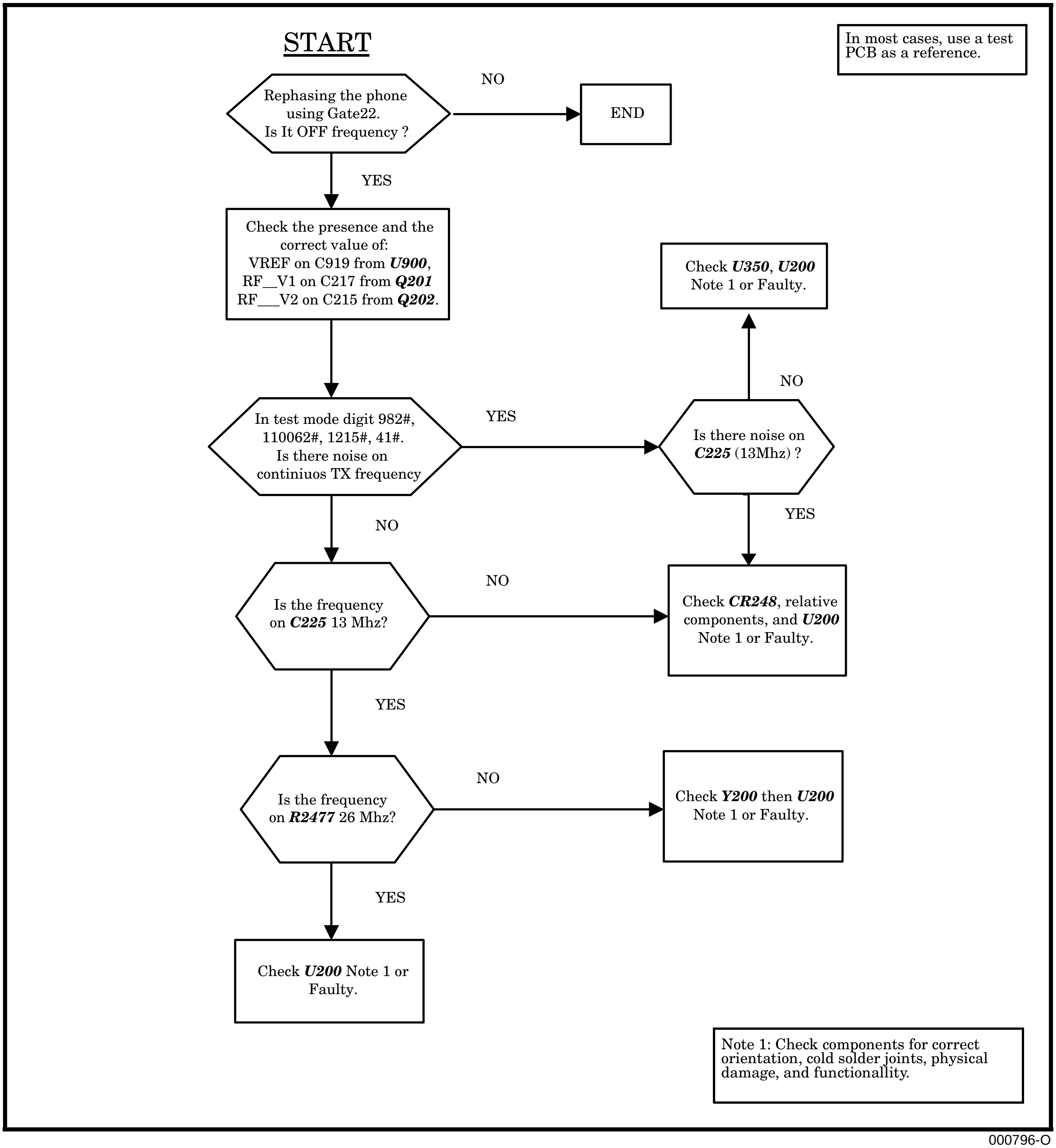


Figure 35. Frequency Error

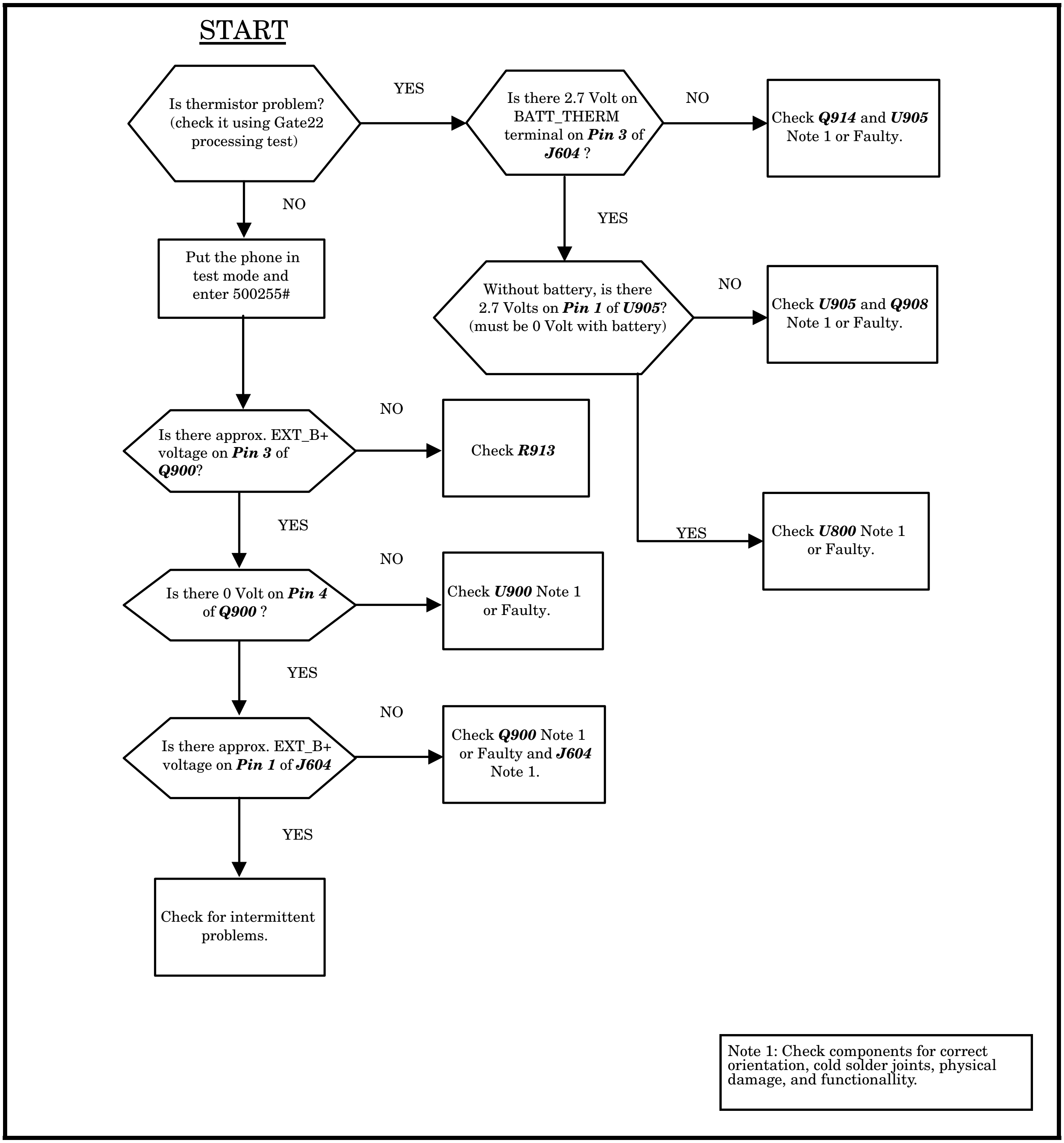
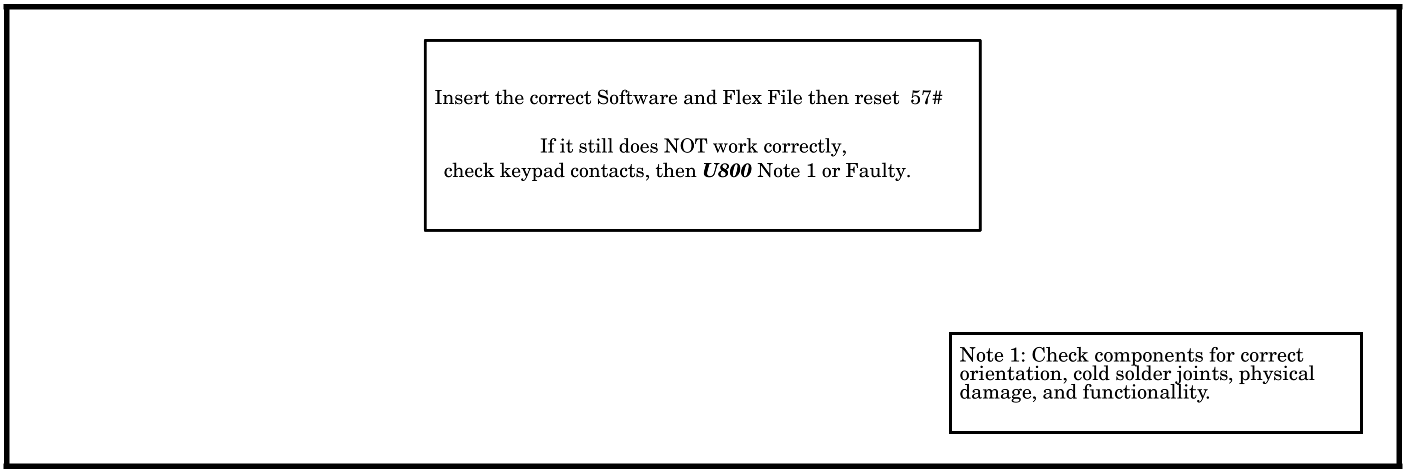
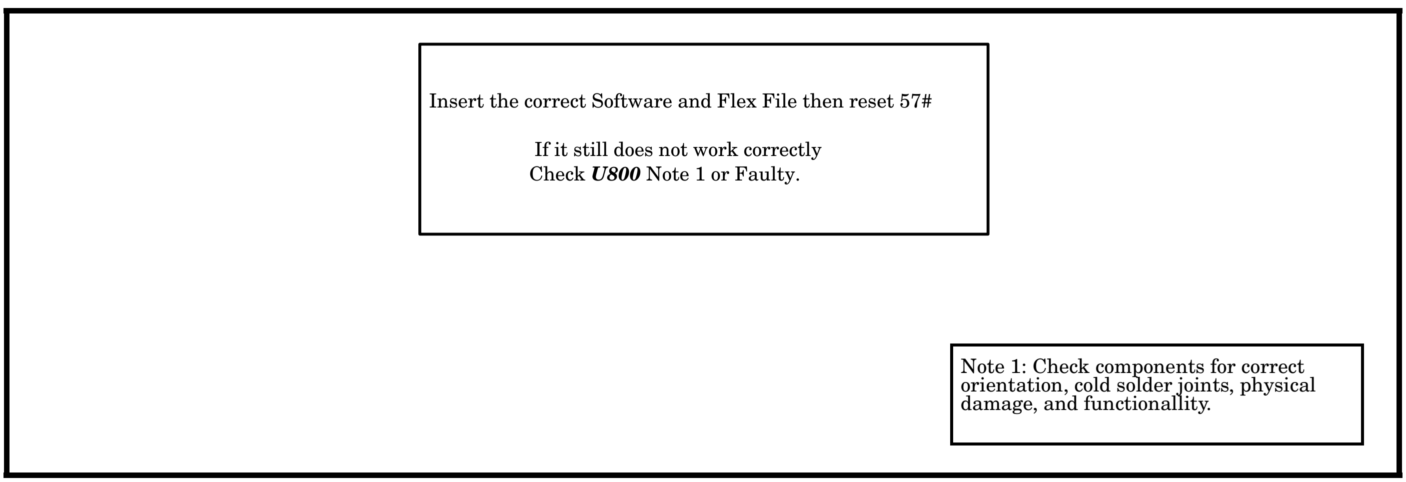


Figure 36. No Charging



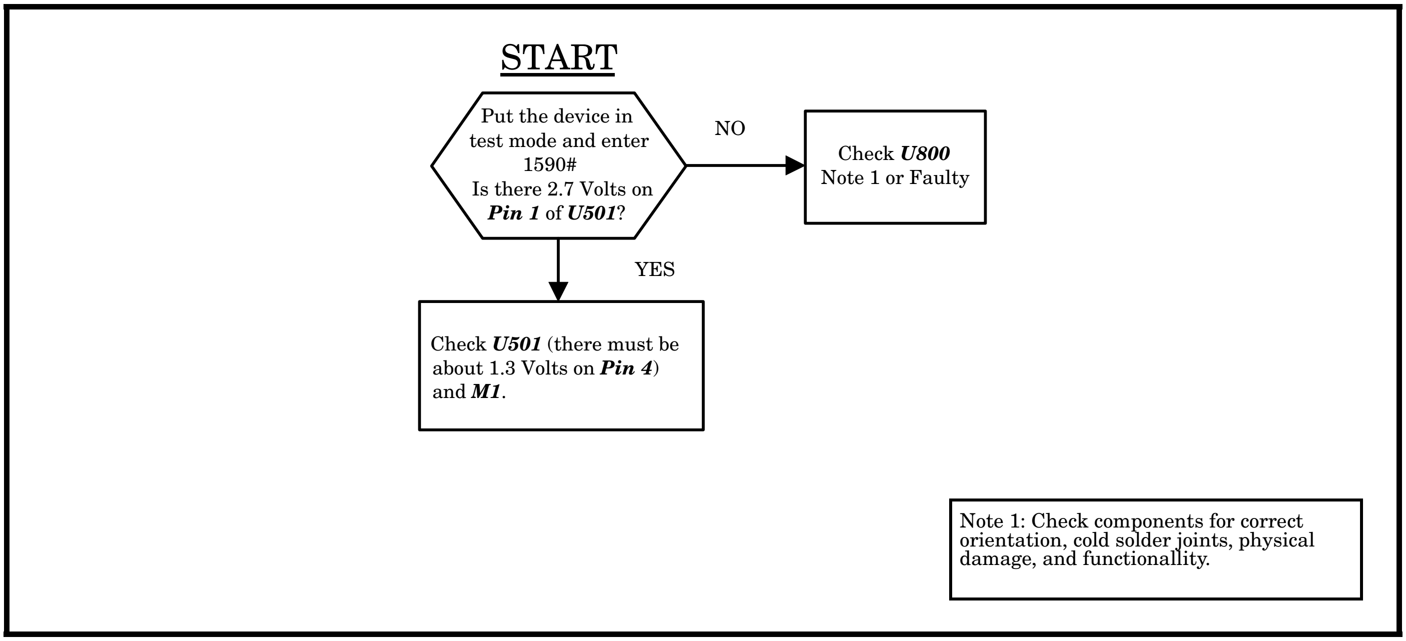
000798-O

Figure 37. Keypad Not Functioning



000799-O

Figure 38. Voice Recognition/Annotation Not Functioning



000800-O

Figure 39. VibraCall® Not Functioning

Part Number Charts

The following part number charts are provided for used as a reference for the transceivers, controllers, and parts associated with Product Family 38C Personal Communicators.

Model Chart

The following model chart represents all the transceivers, controllers, and models associated with Product Family 38C Personal Communicators.

Controller and Transceiver boards are non-replaceable parts for EMEA service centers.

Table 9. PF38C Personal Communicator Model Chart

ITEM NUMBER	DESCRIPTION
SUG1791	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2034)*
SUG1791A	V100 Transceiver/Controller Board Set, Dual-Band*
SUG1792	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2035)*
SUG1792A	V100 Transceiver/Controller Board Set, Dual-Band*
SUG1806	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2036)*
SUG2503	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2533)*
SUG2504	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2534)*
SUG2505	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2532)*
SUG2034	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG1791)*
SUG2035	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG1792)*
SUG2036	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG1806)*
SUG2532	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG2505)*
SUG2533	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG2503)*
SUG2534	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG2504)*

SUG1791	SUG1791A	SUG1792	SUG1792A	SUG1806	SUG2503	SUG2504	SUG2505	SUG2034	SUG2035	SUG2036	SUG2532	SUG2533	SUG2534	MODEL NUMBER	
X								X						SE2036AA5B1	V100, British, Ocean Jaxx
X								X						SE2036AA5D1	V100, Dutch, Ocean Jaxx
X								X						SE2036AA5E1	V100, French, Ocean Jaxx
X								X						SE2036AA5F1	V100, Spanish, Ocean Jaxx
X								X						SE2036AA5H1	V100, Italian, Ocean Jaxx
X								X						SE2036AA5J1	V100, Norwegian, Ocean Jaxx
X								X						SE2036AA5L1	V100, Spanish, Ocean Jaxx
X								X						SE2036AA5M1	V100, Swedish, Ocean Jaxx

Key: X = Included R = Request Option ***NOTE:** Non-replaceable parts for EMEA service centers

Table 9. PF38C Personal Communicator Model Chart (Continued)

ITEM NUMBER	DESCRIPTION
SUG1791	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2034)*****
SUG1791A	V100 Transceiver/Controller Board Set, Dual-Band*
SUG1792	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2035)*****
SUG1792A	V100 Transceiver/Controller Board Set, Dual-Band*
SUG1806	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2036)*****
SUG2503	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2533)*****
SUG2504	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2534)*****
SUG2505	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2532)*****
SUG2034	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG1791)*****
SUG2035	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG1792)*****
SUG2036	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG1806)*****
SUG2532	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG2505)*****
SUG2533	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG2503)*****
SUG2534	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG2504)*****

SUG1791	SUG1791A	SUG1792	SUG1792A	SUG1806	SUG2503	SUG2504	SUG2505	SUG2034	SUG2035	SUG2036	SUG2532	SUG2533	SUG2534	MODEL NUMBER	DESCRIPTION
X								X						SE2036AA5R1	V100, Hungarian, Ocean Jaxx
		X							X					SE2036AX4B1	V100, British, Klub Blue
		X							X					SE2036AX4D1	V100, Dutch, Klub Blue
		X							X					SE2036AX4E1	V100, French, Klub Blue
		X							X					SE2036AX4F1	V100, German, Klub Blue
		X							X					SE2036AX4H1	V100, Italian, Klub Blue
		X							X					SE2036AX4J1	V100, Norwegian, Klub Blue
		X							X					SE2036AX4L1	V100, Spanish, Klub Blue
		X							X					SE2036AX4M1	V100, Swedish, Klub Blue
		X							X					SE2036AX4R1	V100, Hungarian, Klub Blue
				X						X				SE2036AY4B1	V100, British, Explosive Sonic
				X						X				SE2036AY4D1	V100, Dutch, Explosive Sonic
				X						X				SE2036AY4E1	V100, French, Explosive Sonic
				X						X				SE2036AY4F1	V100, German, Explosive Sonic
				X						X				SE2036AY4H1	V100, Italian, Explosive Sonic
				X						X				SE2036AY4J1	V100, Norwegian, Explosive Sonic
				X						X				SE2036AY4L1	V100, Spanish, Explosive Sonic
				X						X				SE2036AY4M1	V100, Swedish, Explosive Sonic
				X						X				SE2036AY4R1	V100, Hungarian, Explosive Sonic
		X							X					SE2134AX4E3	V100, French, Klub Blue
X								X						SE2172AA5L2	V100, Spanish, Ocean Jaxx
		X							X					SE2172AX4L2	V100, Spanish, Klub Blue

Key: X = Included R = Request Option ***NOTE:** Non-replaceable parts for EMEA service centers

Table 9. PF38C Personal Communicator Model Chart (Continued)

ITEM NUMBER	DESCRIPTION
SUG1791	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2034)*****
SUG1791A	V100 Transceiver/Controller Board Set, Dual-Band*
SUG1792	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2035)*****
SUG1792A	V100 Transceiver/Controller Board Set, Dual-Band*
SUG1806	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2036)*****
SUG2503	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2533)*****
SUG2504	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2534)*****
SUG2505	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2532)*****
SUG2034	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG1791)*****
SUG2035	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG1792)*****
SUG2036	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG1806)*****
SUG2532	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG2505)*****
SUG2533	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG2503)*****
SUG2534	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG2504)*****

SUG1791	SUG1791A	SUG1792	SUG1792A	SUG1806	SUG2503	SUG2504	SUG2505	SUG2034	SUG2035	SUG2036	SUG2532	SUG2533	SUG2534	MODEL NUMBER	DESCRIPTION
X								X						SE2173AA5L2	V100, Spanish, Ocean Jaxx
		X							X					SE2173AX4L2	V100, Spanish, Klub Blue
			X											SE2174AX4L4	V100, Spanish, Klub Blue
	X													SE2174AA5L4	V100, Spanish, Ocean Jaxx
X								X						SE2175AA5L3	V100, Spanish, Ocean Jaxx
		X							X					SE2175AX4L3	V100, Spanish, Klub Blue
X								X						SE2176AA5L3	V100, Spanish, Ocean Jaxx
		X							X					SE2176AX4L3	V100, Spanish, Klub Blue
X								X						SE2177AA5Q2	V100, Turkish, Ocean Jaxx
		X							X					SE2177AX4Q2	V100, Turkish, Klub Blue
		X							X					SE2178AX4E4	V100, French, Klub Blue
		X							X					SE2182AX4B3	V100, British, Klub Blue
X								X						SE2188AA5F8	V100, German, Ocean Jaxx
		X							X					SE2188AX4F8	V100, German, Klub Blue
X								X						SE2189AA5H2	V100, Italian, Ocean Jaxx
		X							X					SE2189AX4H2	V100, Italian, Klub Blue
		X							X					SE2190AX4B3	V100, British, Klub Blue
X								X						SE2344AA5Y3	V100, Czechoslovakian, Ocean Jaxx
		X							X					SE2359AX4B1	V100, British, Klub Blue
		X							X					SE2360AX4H4	V100, Italian, Klub Blue
		X							X					SE2361AX4B8	V100, British, Klub Blue
X								X						SE2362AA5A7	V100, Dutch, Ocean Jaxx

Key: X = Included R = Request Option ***NOTE:** Non-replaceable parts for EMEA service centers

Table 9. PF38C Personal Communicator Model Chart (Continued)

ITEM NUMBER	DESCRIPTION
SUG1791	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2034)*
SUG1791A	V100 Transceiver/Controller Board Set, Dual-Band*
SUG1792	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2035)*
SUG1792A	V100 Transceiver/Controller Board Set, Dual-Band*
SUG1806	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2036)*
SUG2503	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2533)*
SUG2504	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2534)*
SUG2505	V100 Transceiver/Controller Board Set, Dual-Band (Replace with SUG2532)*
SUG2034	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG1791)*
SUG2035	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG1792)*
SUG2036	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG1806)*
SUG2532	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG2505)*
SUG2533	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG2503)*
SUG2534	V100 Service Transceiver/Controller Board Set, Dual-Band (Replacement for SUG2504)*

SUG1791	SUG1791A	SUG1792	SUG1792A	SUG1806	SUG2503	SUG2504	SUG2505	SUG2034	SUG2035	SUG2036	SUG2532	SUG2533	SUG2534	MODEL NUMBER	DESCRIPTION
		X							X					SE2362AX4A7	V100, Dutch, Klub Blue
		X							X					SE2363AX4V4	V100, British, Klub Blue
		X							X					SE2364AX4B7	V100, British, Klub Blue
		X							X					SE2365AX4B4	V100, British, Klub Blue
X								X						SE2393AX4E1	V100, French, Klub Blue
		X							X					SE2393AX4E1	V100, French, Klub Blue
		X												SE2440AX4B5	V100, British, Klub Blue
			X											SE2497AX4Y3	V100, Czechoslovakian, Klub Blue
	X													SE2497AA5Y3	V100, Czechoslovakian, Ocean Jaxx
		X	X											SE2498AX4B1	V100, British, Klub Blue
			X											SE2534AX4K2	V100, Portuguese, Klub Blue
	X													SE2534AA5K2	V100, Portuguese, Ocean Jaxx
					X							X		(USA ONLY)	V100, USA, Klub Blue
						X							X	(USA ONLY)	V100, USA, Explosive Sonic
							X				X			(USA ONLY)	V100, USA, Ocean Jaxx

Key: X = Included R = Request Option ***NOTE:** Non-replaceable parts for EMEA service centers

Identity and Security

Each Motorola GSM device is labelled with various number configurations. The following information describes these configurations.

Mechanical Serial Number (MSN)

The Mechanical Serial Number (MSN) is an individual unit identity number and remains with the unit throughout the life of the unit.

The MSN can be used to log and track a unit on Motorola's service center database.

The MSN is divided into 4 sections (see Figure 40).

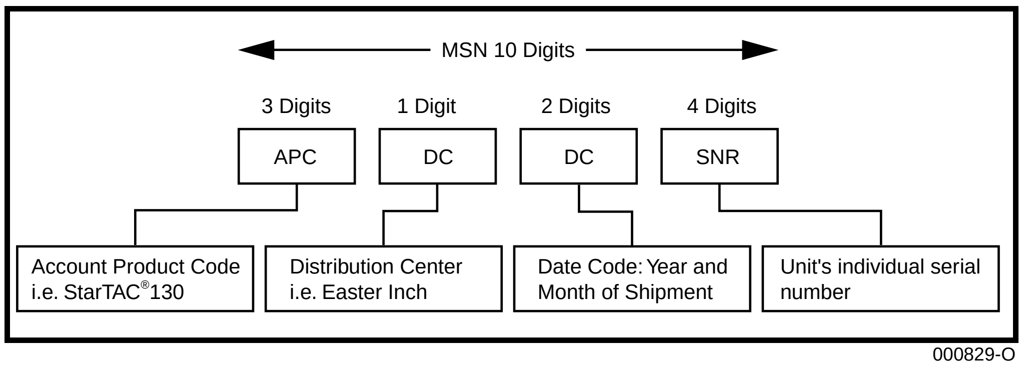


Figure 40. MSN Label

International Mobile station Equipment Identity (IMEI)

The International Mobile station Equipment Identity (IMEI) number is an individual number unique to the PCB and is stored within the unit's memory. Figure 41 provides a description of the sections of this number.

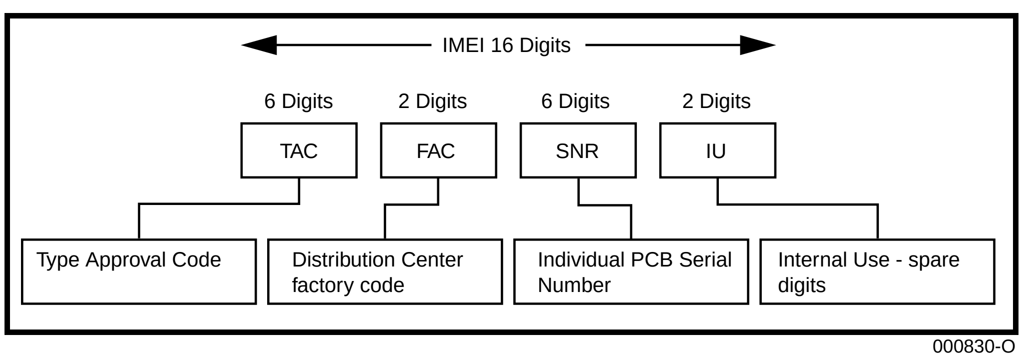


Figure 41. IMEI Label

Other label number configurations present are:

- **TRANSCEIVER NUMBER**: Identifies the product type. Normally the SWF number. (i.e. V100).
- **PACKAGE NUMBER**: Identifies the equipment type, the mode and language in which the product is shipped.

Picasso Tracking Label

The number recorded on the Picasso label, when used with the MSN, allows precise identification of the device's origin. By tracking field failures back to the site, shift, and line of manufacture, failure trends can be quickly diagnosed and corrected at the source.

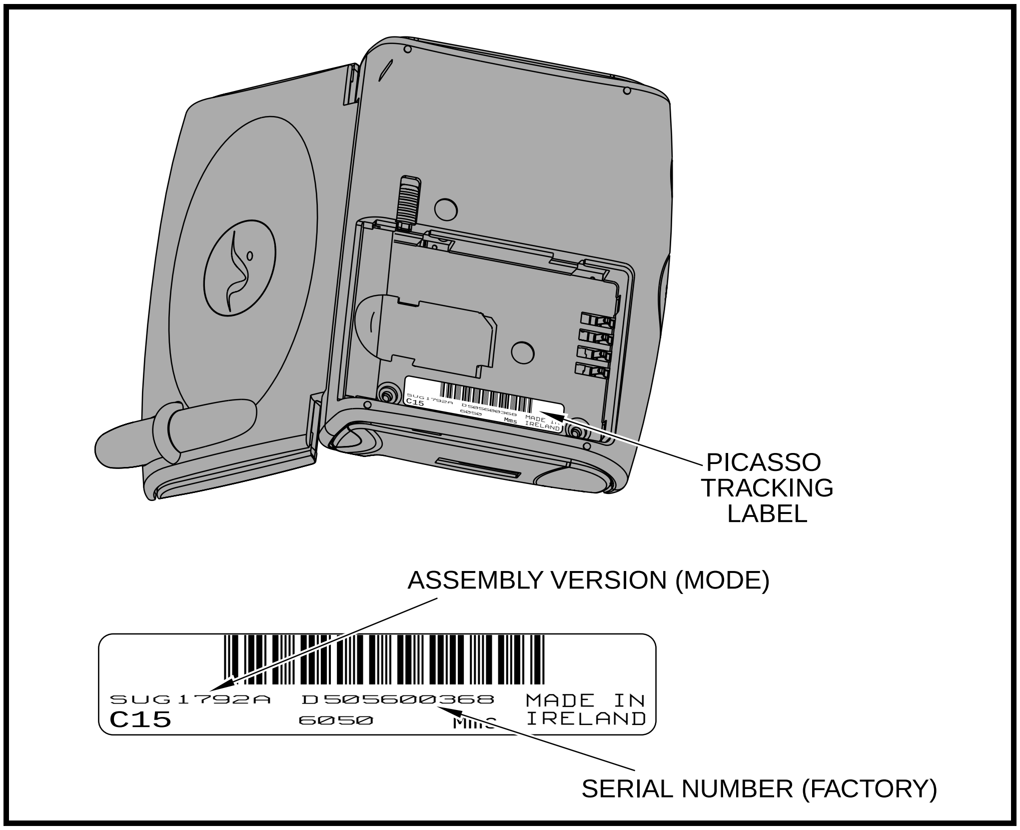


Figure 42. Picasso Tracking Label

Related Publications

PF38C Service Manual Level 1 and 2	6881036B15
PF38C Controller Supplement	6881104B83
PF38C Transceiver Supplement	6881111B05

Exploded View Diagram

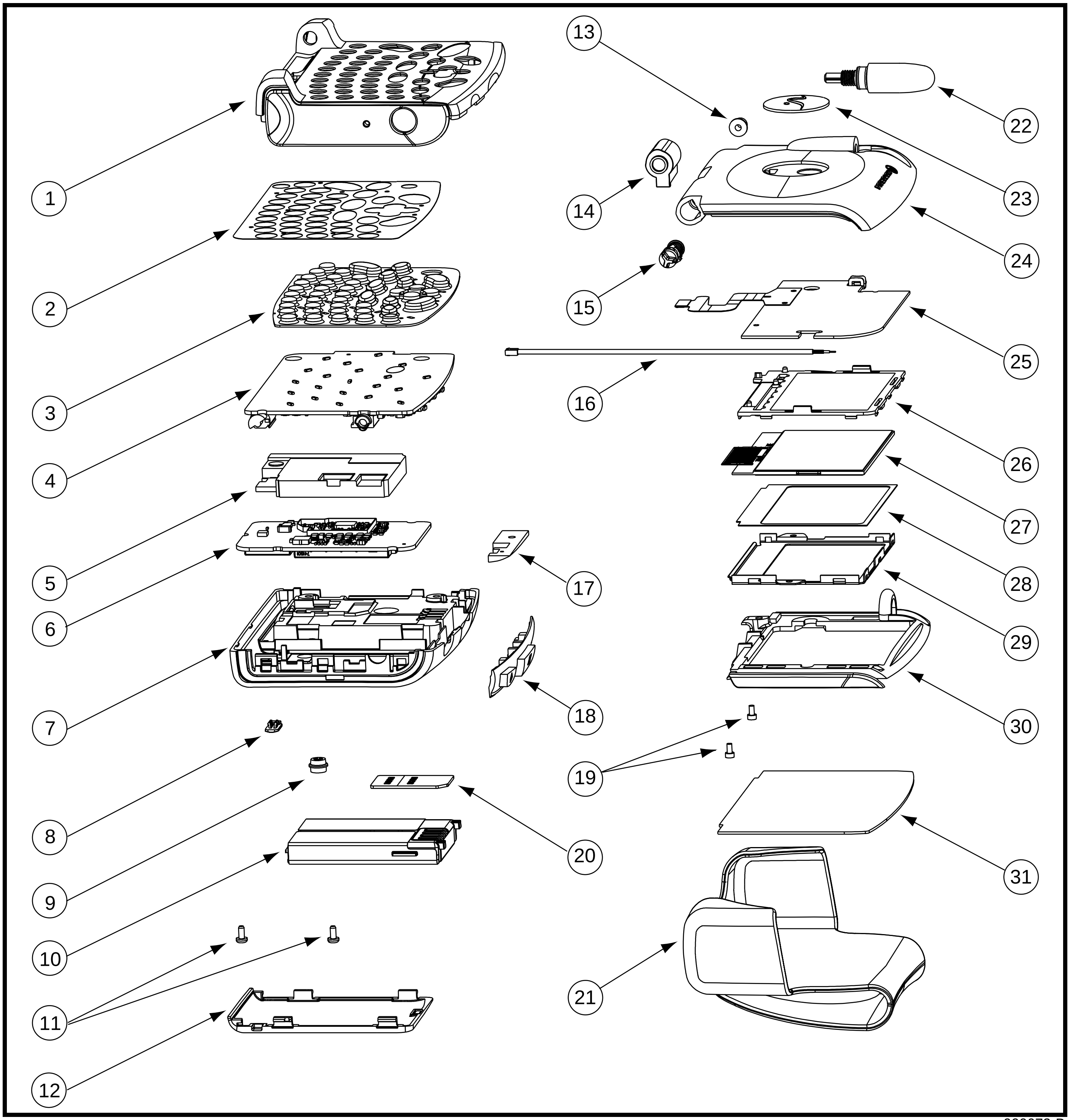


Figure 43. Exploded View Diagram

Exploded View Parts List

Table 10. Exploded View Parts List

Item Number	Motorola Part Number	Description
1	See Note 5	Base Inside Housing Assembly
2	3386460K01	Reflector, Keypad
3	See Note 5	Keypad, QWERTY
4	See Table 9	Controller PCB
5	7586410K01	Snubber, Board to Board
6	See Table 9	Transceiver PCB
7	See Note 2	Base Back Cover Housing, Outside
8	See Note 2	Lock, Battery Door
9	2886472K01	RF Plug
10	See Note 5	Battery, Lithium Ion
11	0362035B17	Screws (2) Back Housing
12	See Note 2	Door, Battery
13	4308800E01	Bushing
14	See Note 5	Flex Cover (barrel)
15	5504765Z06	Hinge (Cam)
16	3086439K01	Coaxial Cable
17	4586461K01	Snubber, Board Support
18	See Note 2	External Keys
19	0310944A85	Screws (2), LCD
20	See Note 4	SIM Card
21	See Note 5	Holster
22	8586338K01	Antenna
23	6186427K01	Medallion
24	See Note 5	Flip Housing, Outside
25	See Note 3	Antenna/Display PCB
26	6186409K01	Light Guide
27	See Note 3	LCD w/ COG Driver
28	32864899K01	Gasket, LCD
29	0786408K01	Bezel (LCD Frame)
30	See Note 5	Flip Housing, Inside (LCD Cover)
31	See Note 5	Lens
32	See Note 5	Flip Assembly (includes items 1, 13-16, 19, and 22-31)
33	See Note 5	Base Back Cover Housing Assembly (includes items 7- 9, and 12)
34	0186446K01	LCD Assembly (includes items 25, 27, and 28)

Notes:
1. Order next higher assembly, item number 32.
2. Order next higher assembly, item number 33.
3. Order next higher assembly, item number 34.
4. Non-replaceable part for EMEA service centers.
5. Refer to the Level 1 and 2 Service Manual for part number information.

There is a danger of explosion if the Lithium Ion battery pack is replaced incorrectly. Replace only with the same type of battery or equivalent as recommended by the battery manufacturer. Dispose of used batteries according to the manufacturer's instructions.

Index

V

W

Personal Communications Sector,
1500 Gateway Blvd.
Boynton Beach, FL 33426-8292
Printed in U.S.A. 11/00

6881036B20-O